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The Unity of Knowledge

IN his anniversary address to the Royal Society, Sir William Bragg has treated a subject which, as he said, seems to exhibit a greater importance the more closely it is examined. The very great increase in the output of the records of research has placed scientific societies in a difficult position. There is correspondingly more to be published and, at the same time, publication costs have increased. The long rows of periodicals on the shelves continue to grow, the annual volumes increase in size and divide into two or four. Still the papers come pouring in, and even the rate of flow increases. It is a healthy growth, which we do not wish to check; but the practical difficulties need to be solved.

The principal reason for the publication of the results of research is that they may be of service to mankind. The preparation and presentation of these records so that they may be sufficiently appreciated and can be incorporated with understanding into every activity, scientific, intellectual and physical, to which they may apply, is one of the essential duties of a society. In Sir William Bragg's own words, "We are, at least, bound to see that our acquired knowledge is rightly stated so that it can be rightly used." Because the results of research have become so voluminous and so important, the manner of stating them, of arranging them and of storing them, has also become important.

The proper appreciation and application of new discoveries is being hindered at present by increasing specialization, employing a terminology and a mathematical apparatus which are intelligible only to a few specialists in some one subject. Anyone who has completed a piece of research may think it necessary to set out his facts in detail for the use of the expert who is working in the same subject, and is familiar with the technical terms and the hidden difficulties. Yet such writings make dull and difficult reading for the great majority of those who are interested in scientific discovery. The number of those who can study critically a paper of a certain type is distressingly few. The difficulty even of finding referees capable of judging its merits is known only too well. The paucity of attendance and the lack of good discussion, when such papers are read, is so disappointing that an increasing number of papers are taken as read.

The publication in advance, in the *Proceedings of the Royal Society*, of summaries of papers received has been appreciated, as providing both an earlier announcement of discovery, as well as giving a general idea of the trend of research to those who are not specialists. Such summaries are the expression of a natural reaction to the increasing difficulties due to growing specialization, which tends to take discoverers out of sight of each other and of the main body of scientific workers. Summaries indicate the recognition of a principle, which demands acceptance, namely, that discovery must be accompanied by exposition.

The summaries required are more than mere digests of papers. They differ from the papers themselves in being addressed to a wider circle of readers, a circle that may include the experts, but which contains also many others, who should, in fact, receive the principal attention. Such a summary may be more difficult to write than the paper, because it must take into account the interests and modes of thought of those who may be unable to read the paper itself, but will gladly absorb its meaning, especially if there is a connexion with their own work. When the summary is written with this wider view it becomes literature,

though the paper itself may be no more than a record. The only way to facilitate the growth of a sound general opinion is to insist that a general account shall be given that is intelligible to a sufficient number.

Now, if the scientific worker is required, not merely to observe and to record, but also to share his knowledge with the world, he needs certain qualifications and a certain education, which are less necessary in the more restricted field. He is dealing not merely with facts, but also with men: his work enters the humanities. As Sir William Bragg points out, this is really a great matter. Its importance arises from the tremendous consequences, which are now obvious, of the increase of knowledge of Nature. To charge scientific men with the responsibility for the evil uses sometimes made of their discoveries is absurd. But this responsibility is theirs, that they shall explain what they find so that it may be properly understood; and none but themselves can rightly describe it.

This problem, urgent as it is, cannot be fully solved while school and college still maintain an artificial division between two forms of teaching, respectively described as 'science' and the 'humanities'. If Plato was right in defining science as knowledge of what eternally exists and not what comes for a moment into existence and then perishes, science and the humanities are one. The "Principia" is an item of literature, as the discovery of radium is an event in history. The artificial separation of science from the humanities in education tends to the division of the adult into two distinct classes, whose minds are complementary, the one to the other, but each essentially incomplete and incapable of comprehending truth as a whole. Mutual distrust may result in afterlife. The seeds of social strife are sown at school. May not present international disputes be traced in large measure to defects in national systems of education? The existence of this evil is too evident to need examination. Steps must be taken to eradicate it now. The basis of education must be broadened. The humanist must learn to understand the inner working of the common things of life. As Pope would teach him:

"Go, from the creatures thy instruction take.
Learn from the birds what food the thickets yield;
Learn from the beasts the physic of the field;
The art of building from the bee receive;
Learn of the mole to plough, the worm to weave;
Learn of the little nautilus to sail,
Spread the thin oar, and catch the driving gale."

Likewise the man of science should learn from the same poet that:

"True expression, like th' unchanging sun,
Clears and improves whate'er it shines upon;
It gilds all objects, but it alters none."

Specialization there must be, of course—a divergence in study at later stages. But men of different types of mind must be kept together more than at present, so that, when they meet in the affairs of the world, they can understand each other. Practical difficulties can be surmounted, now that the need is clear. The sharp distinction must disappear. Education must be founded on the unity of knowledge.

Already the humanities and science have joined hands in the service of mankind. Scientific societies can contribute towards the needed reform by insisting on the publication of adequate summaries of original contributions to knowledge. When a new departure in experiment or theory is made, or a new fact is discovered, a careful and complete explanation must be made. If the novelty leads, as often, to a steady output of observation, extension, confirmation and illustration, there must come a time when complete publication to the world becomes unnecessary and even tiresome. Summaries, properly written, of such continuation material should be enough. For the benefit of the comparatively few experts who need them, photographic reproduction of the complete material could be made at a fraction of the cost of printing. The proceedings of societies would thus become more handy, interesting and useful, and their cost would be reduced.

The so-called micro-film, the use of which is discussed in an article on pp. 393-395, offers one means for the photographic reproduction of bulky reports. Complete copies of lengthy documents can be prepared on cinematograph film at the cost of a penny or so a page, and these can be read, in libraries or the private home, by means of optical projectors that enlarge the pictures to full size. The method has now well passed the experimental stage. Already it is being used extensively for the reproduction of articles in periodicals, rare and out-of-print books, manuscripts and documents of all kinds. The United States has taken the lead in the exploitation of the new process. The time is ripe for the creation in Great Britain of a centre, where micro-films and other photographic reproductions of material for the use of scholars can be produced with economy and efficiency.

Documentary Photography and Research

By Dr. S. C. Bradford

RECOGNITION of the document, manuscript or printed, as an instrument of research, demands intensive study of the processes of collecting, classifying and distributing documents. Prominent among the subjects considered during the past twenty years, in the circles concerned with this endeavour, has been the photographic reproduction of documents, and especially the application of the micro-film to this end.

The value of the method is now recognized alike by historians and scientific men. Recently its importance was emphasized by Sir William Bragg in his anniversary address to the Royal Society. Photography has become the most suitable means of reproducing books and manuscripts, of which a comparatively small number of copies is required. It may be employed to serve the needs of a particular student, or, as a means of publication, alternative to the issue of a printed text. It is suitable as a method for the preservation of material, whether in print or manuscript, which is perishable in nature, or of considerable bulk in its original form.

Of the various photographic processes available for the reproduction of documents, collotype and photolithography have already taken their place as everyday operations of printing. It is time to consider how best to make use of the facilities offered by photography for the production of a smaller number of copies of documents. This is a matter of considerable moment, in which the scientific public is intimately concerned. It is important that the public should be cognizant of the relevant facts, which shall be stated succinctly.

The photostat and its various modifications are too well known to need description. Two other processes are specially notable, namely, reflection copying and microphotography. Perhaps the former is of greater theoretical interest. In this method, sensitized paper is pressed into contact with the material to be copied, so that light may pass through the photosensitive layer to the surface of the document, whence it is reflected back again through the sensitive layer. The difference in the amount of light reflected from the dark and light portions of the document is utilized to form the photographic image, which is produced in continuous tones, though with rather greater contrast. Silver bromide paper may be used in the process, giving a full-size reversed negative image, from which positive 'prints' must be made. Such are the Ruthurstat and Rectophot processes.

Perhaps the most intriguing, and at the same time most valuable, method is the so-called Retocee process, of recent introduction, and using thin sheets of 'Cellophane' coated on one side with a diazo compound. After exposure to an arc light, mechanized treatment with a suitable solution immediately develops a full-size positive image by the formation of a dye-stuff. The picture becomes dry instantaneously and is made ready for delivery by pressing the tissue on to a sheet of tacky white paper to show up the image. The complete operation occupies three minutes. Should a number of copies be required, they can be printed at the rate of perhaps three or more a minute, in black on white paper, from a brown-toned transparency, at a cost of a farthing a piece, for octavo size. Neither lens nor shutter is needed in the apparatus, which can be operated by any member of the staff in full daylight. At present, the cost of the materials for making a single positive copy by this method is very slightly more than that for a negative copy by the photostat method, or scarcely more than half the cost for a positive copy; the difference being negligible in comparison with the labour and overhead charges involved, which may amount to half a crown for each order of an average of four pages. The apparatus itself, of course, is much cheaper, while the cost of producing a number of copies is remarkably low. Now that typewriters are available with a double shift, giving three characters to a key and a range ample for typing scientific papers, this method is very suitable for the reproduction of such papers, of too limited an interest to justify printing.

The microphotographic process, which, on account of its cheapness, the small bulk of the copy, and the need for the production of grainless films and the design of new types of apparatus, has stimulated so much interest in documentary photography, was first described in 1907 by an eminent Belgian, Prof. Robert B. Goldsmidt, and M. Paul Otlet, who is well known as one of the founders of the International Federation for Documentation. Their invention was published in the Belgian *Journal des Brevets*, in an article entitled "Une forme nouvelle du livre—Le livre micro-photographique". The process consisted in the microphotographical reproduction of documents on standard cinematograph film and their enlargement for reading by the projection of an optical image. The term 'photoscope', given originally by Prof. Goldsmidt to his reading apparatus, can scarcely be improved. Complete mechanization of the method has

enabled exposures in a continuous run to be made at the rate of three or four hundred an hour, with a corresponding speed of processing the film and a resulting cost for material of about a halfpenny per exposure. The design of a perfect photoscope has presented the greatest difficulty, and although tolerably efficient instruments are now on the market, room for improvement still remains. As an alternative method, the micro-negative may be enlarged into a full-size positive photograph. But this method, involving two exposures, cannot compete in cost with methods that produce positive copies directly. Necessarily the same overhead charges apply, as with other methods. These completely swamp the cost of materials, when only a few pages are ordered, so that the cheapness of the process is fully realized only when applied to the reproduction of a large number of pages at a time.

Thus, as was foreseen by its inventors, the great value of this method lies in its application (1) to the reproduction of bulky material, such as complete manuscripts, rare books and newspapers, and (2) as a potential means for the publication of records, reports and other documents of too limited an interest to bear the cost of printing.

The microphotographic method is suitable for the reproduction of works of considerable length, whether in a few or a comparatively large number of copies. By its means, masses of historical material could be made available or more readily accessible to the student. The method can be used to supply individual students with copies of otherwise unprocurable books, or to relieve the librarian of anxiety caused by the too frequent handling of rare originals. It may have greater value as a means of reproducing large works of reference, such as the Statutes of the Realm, or of assembling complete texts from widely scattered originals. The process makes possible the study, in the reader's own home, of the foreign press, in a manner which can be achieved at present only by prolonged visits abroad. Film photographs can be used for the preservation of records otherwise likely to be destroyed. Microphotography of newspapers facilitates the collection of complete files of the rarer journals at small cost and provides a method of preservation of such as are liable to disintegration. It relieves libraries of costs for storage and binding. Thus a bound file of the *New York Times* requiring 59 cubic feet of storage space, occupies, in film form, only $1\frac{1}{4}$ cubic feet. The method offers also means of avoiding inter-library loans of rare books.

In adopting photographic methods as a means of publication, the editions produced fall naturally within the scope and protection of the copyright laws. Arrangements must, therefore, be made to satisfy the holders of any copyright in the originals reproduced, as would be done for works published in any other way. No difficulty arises from this fact. But, it is important to discriminate between the use of photography for the publication of a considerable edition of a work, and its utilization as a convenient means of copying an extract from a volume for the purpose of private study, or research. In the past, photographic copies of more or less inaccessible scientific papers have been of much service to research workers, on occasion. This facility should not be limited.

Fears have been expressed that the unrestricted sale of micro-photographs of articles in periodicals might 'kill' the journals. Let us be clear upon this point. In library experience, rarely is a second request received for a photograph of the same article. After the passing of the period when a discovery is first made known, by the publication of an article in a scientific magazine, references to that article are usually confined to single consultations, made by one, or occasionally a few, experts working on a cognate subject, or subjects. Such experts need to refer, not merely to one article, but to a number of articles, published at different times and in different periodicals. For the rapid performance of the bibliographical survey, which must usually precede the commencement of a new laboratory investigation, it is essential that comprehensive libraries should be available, where the experimentalist may find ready to hand the original literature bearing on his work. It is not an assistance, but a hindrance, to have to wait while photographic copies are being made of articles urgently needed for consultation. This applies, whether only one example of the original document exists, or whether a number of copies have been made and deposited in other libraries.

Photographic reproduction will be of service as a new means of publication; copies of periodicals so published will be deposited in libraries; but photography will not take the place of libraries, or kill the journals. Only when a library does not contain a copy of a paper needed by a research worker, is he glad to avail himself of the possibility of obtaining a photograph from another library. He would soon complain, if his library should cease to take periodicals, in the hope of satisfying him with photographs obtained from other sources.

A single photographic copy of an extract, whether of microscopic or legible size, becomes useful when the work itself is not available for consultation. The supply of such copies is not publication, in the sense of making available to the general public. It has not restricted the continual growth in number of new periodicals, nor does it appear to have diminished their circulation. Publishers have

not objected to the practice, and authors are concerned rather to make their discoveries better known. The making of a single copy of an article, by any means, is not a trespass upon the moral rights of the holder of any copyright. Carried to the extreme, such an idea must prevent the loan of books, or even the establishment of libraries for general use. It would be an ill service to science, if the advent of microphotography should be the cause of the suppression of a useful aid to research.

In order to take full advantage of the facilities offered to research workers by the various methods of documentary photography, the organization of the service would require to be placed in the hands of a central institute, which would be in a position to study the many problems involved, to choose the best means of tackling individual cases and to bring about the standardization of apparatus and material. The present tendency to leave the making of photographs of documents to individuals, commercial firms and miscellaneous institutions, working independently, is both wasteful and a source of confusion. Expensive apparatus is used intermittently, overhead charges are increased and experience wasted. Moreover, the lack of agreement upon standard measurements creates the possibility that microphotographs made by one agency may prove to be unreadable upon apparatus available in another place. Already the United States has led the way by the foundation of the American Institute of Documentation. A similar centre is needed in Great Britain, where production may be organized and the fullest efficiency and minimum cost achieved.

Josiah Wedgwood and his Portraits of 18th Century Men of Science*

By Dr. John Thomas

THE eighteenth century gave birth to some remarkably interesting personalities in the realms of both industry and science. From the Midland manufacturers in the persons of Wedgwood, Boulton and Watt, there can be singled a trio who became fellows of the Royal Society. In science, the Midland men of fame include Joseph Priestley and Erasmus Darwin. The spirit of inquiry of the age, with its zest for experiment, led Wedgwood to convert his manufactory into an industrial "elaboratory", as he termed it. He was determined to convert crude clays into artistic ceramic products. He had to wrestle with all the four familiar elements of philosophers in the pre-scientific age—fire, air, earth and water. His "Trial Books" now in the Etruria Museum justify his claim to be considered a man of science.

Josiah Wedgwood was elected a fellow of the Royal Society in 1783, and made several contributions to the *Philosophical Transactions* in 1782, 1784 and 1786. His pyrometer, which was the subject of his Royal Society papers, was the result of experiments extending over a period of six years. It is a very simple instrument marked and graded to indicate the shrinkage of clay bodies when inserted in the potter's oven. At first, Wedgwood placed small cylinders of clay at the wide tapering end, but later he made cylindrical balls or marbles of clay, which he called pyrometrical pieces. These "contraction bits" have been used regularly in potteries the world over since the invention of the pyrometer by Wedgwood.

This thoroughness in scientific exactness was not confined to the firing of the ware, but it permeated the earlier stages of preparing the clay. The potter's mill, like "the mills of God", is expected to "grind exceeding small"; hence Wedgwood's anxiety to replace the wind- or water-mill with the more reliable source of power found later in Watt's steam engine. The Boulton and Watt archives* contain ample evidence of Wedgwood's faith in the new scientific inventions of James Watt. At Etruria, the last steam engine installed by Watt in 1800 worked continually until dismantled in 1912. We thus see a powerful link between Etruria and Soho.

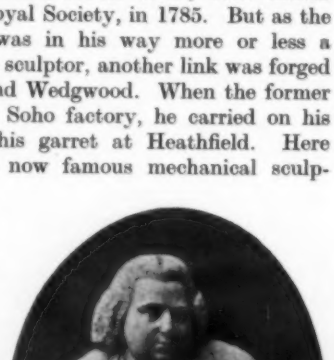
There were earlier links between Wedgwood and Boulton when Fothergill was his partner. In the earlier days of his pottery career, Wedgwood sent small cameos and pottery trinkets to Soho to be mounted in metal before being sold by jewellers. Arising out of this kind of trade, where pottery was a subsidiary of the metal trades, we get a further commercial link, where Boulton and Fothergill often acted as wholesale merchants for Josiah Wedgwood until he later set up his own sales room in London. Like the Prince of Potters,

* From a Friday evening discourse at the Royal Institution delivered on December 16. A small selection only of the many medallions by Wedgwood mentioned during the discourse are reproduced here.

* The Soho order book for steam engines sold to Staffordshire shows orders from Etruria in 1782, 1784, 1793 and 1800. In 1793 Wedgwood drafted a document for Boulton and Watt stating the performance he expected of the steam engine in his pottery.

these two Soho manufacturers, Matthew Boulton and his later partner James Watt, were elected fellows of the Royal Society, in 1785. But as the versatile Watt was in his way more or less a skilled artist and sculptor, another link was forged between Watt and Wedgwood. When the former retired from the Soho factory, he carried on his experiments in his garret at Heathfield. Here he invented his now famous mechanical sculpturing machine for producing enlarged or reduced cameos or busts, "made," as Watt wrote to his friends, "by a young artist just entering on his eighty-third year." The moulds and pottery models for this work were supplied to Watt by his bosom friend, Wedgwood.

Sir Humphry Davy, in a discourse introductory to a course of lectures on chemistry at the Royal Institution in 1802, remarked that the knowledge of chemistry has improved the art of pottery, but he rightly emphasized also that the pottery industry has provided much of the apparatus used in scientific research. Many of these pottery implements Wedgwood supplied freely to his friend, Dr. Joseph Priestley, and even after his death his sons, Josiah and Thomas, provided Davy with porcelain and other apparatus for chemical experiments and demonstrations at the Royal Institution. In fact, Josiah Wedgwood II, when this Institution was founded in 1799, became one of the first proprietors by subscribing one hundred guineas to its funds.



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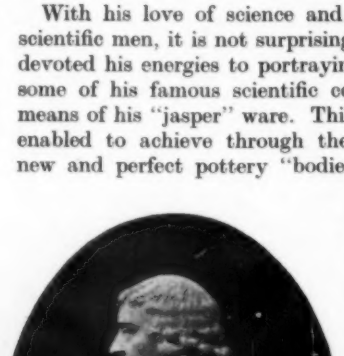

JOSIAH WEDGWOOD.

JOSEPH PRIESTLEY.

SIR JOSEPH BANKS.

SOME WEDGWOOD MEDALLIONS.
Photo: E. Harrison and Son.

WEDGWOOD PORTRAYS MEN OF THE 18TH CENTURY

With his love of science and association with scientific men, it is not surprising that Wedgwood devoted his energies to portraying the features of some of his famous scientific contemporaries by means of his "jasper" ware. This triumph he was enabled to achieve through the medium of his new and perfect pottery "bodies". The soul of Wedgwood ware lay to a large extent in its "body". One body, used for black busts, he called "basaltes". Later he discovered a body called "jasper", generally blue, green or lilac, which he used for the base or background of his portrait medallions, using white jasper for the raised faces or heads and shoulders. This body, while plastic and unfired, is pressed into a mould, which has been cast or made in plaster of Paris, usually from a design by some artist.

THE MAKERS OF THE MEDALLIONS

The three partners associated in the production of most of the medallions [a large collection was on view in the library of the Royal Institution] were Josiah Wedgwood, Thomas Bentley, his first partner at Etruria, and, after the latter's death, Wedgwood's nephew, Thomas Byerley.

Bentley was a cultured Liverpool gentleman who, while in the North, was one of the founders of the famous Warrington Academy, which was the training ground of so many fellows of the Royal Society, for example, Joseph Priestley, Thomas

Pennant, and others. When Bentley removed to Chelsea his artistic temperament delighted in the company of a neighbour, Sir Joseph Banks. Bentley was a regular subscriber to the Royal Society of Arts, and he it was who spotted young Flaxman, at the age of twelve years, as a premium winner, and recommended him to the notice of Wedgwood. Until his death in 1795, Wedgwood made his nephew Byerley his partner, after giving him a good training in his own business methods at Etruria. In addition, Wedgwood had his two sons, Josiah and Thomas, as active partners from 1793. For some strange but presumably good reason, Wedgwood never made a medallion of any of his children. He was content to leave them to the skill of the artist George Stubbs, R.A., in his well-known painting of the Wedgwood family.

There was a host of artists engaged by Wedgwood for the designing and modelling of many of his medallions. From the artistic point of view the best was undoubtedly the master sculptor Flaxman.

WEDGWOOD BLACK BASALTES BUST OF NEWTON.

LEARNED SOCIETIES IN THE PROVINCES: THE STAFFORDSHIRE LUNAR SOCIETY

Long before Wedgwood became a fellow of the Royal Society, he had been introduced to the circle of Midland men of science or philosophers calling themselves the "Lunar Society". It was an informal club or association of scientific men formed about 1766 by Erasmus Darwin and Matthew Boulton. The "Lunar Society" was later joined by new and brilliant recruits, like Joseph Priestley and James Watt. The members met at each other's houses every Monday nearest to the full moon, "in order to have the benefit of its light in returning home," stated Priestley. Hence its name, "Lunar Society". The members were accustomed to dine at 2 o'clock, and parted company at 8 p.m., after exchanging views on scientific topics. Wedgwood made two excellent medallions of Darwin and Priestley.

Members of the Lunar Society were allowed to introduce friends, and thus many distinguished guests were present at these philosophical and scientific banquets. Among these were fellows of the Royal Society from London and sometimes from abroad. Wedgwood made medallions of several of them, including Sir Joseph Banks, Dr. Solander, Sir William Herschel, and Dr. Peter Camper. Some writers place Wedgwood among the *visitors* to the Society, but judging from his correspondence, I would be inclined to rate him as a *member*.

The Lunar Society in the Midlands was only one of many provincial learned societies. Spalding's Gentlemen's Society, of which Sir Isaac Newton was a member, goes back as far as 1710. In Liverpool, Bentley, Roscoe and Currie formed a scientific group. At Warrington, Dr. Aikin and, later, Dr. Priestley, before he removed to Birmingham, had been the scientific centre of another active coterie. Later, at Bristol, we had Dr. Beddoes, with his young assistant, Humphry Davy, the centre of a scientific circle. At Norwich a scientific group centred round the Taylors and the Martineaus.

Wedgwood made medallions of several presidents of the Royal Society, and there are in existence two by him of Sir Christopher Wren and Dr. Martin Folkes. Of the Royal Society medallists portrayed by him, I will comment upon two only, although all are worthy of passing note.

Dr. Joseph Priestley was awarded the Copley medal in 1772 for his experiments and paper on soda water. Then, when Priestley resigned his post with Lord Shelburne to reside in Birmingham, Wedgwood generously afforded him an annual allowance of 25 guineas, a sum continued after Josiah Wedgwood's death by his son until Priestley died. In addition, Wedgwood readily came forward with generous gifts of money and goods to Priestley when the rioters burnt down his laboratory and house in Birmingham. In addition to his medallions of Priestley, Wedgwood made a fine black basaltes bust.

The Wedgwood medallion of Captain James Cook is a fine one, showing the courageous face of the circumnavigator. The portrait is a replica of the Cook medal by Pingo, specially struck by the Royal Society at the instigation of Sir Joseph Banks in 1779. Though Captain Cook died on his third voyage to the South Seas, he immortalized himself, and the two fellows of the Royal Society who accompanied him, Sir Joseph Banks and Dr. Solander, naming parts of the land discovered in

New South Wales after them; they also insisted on naming a river Cook's River. The name "Botany Bay" was a special tribute by Captain Cook to his scientific companions.

Naturally, Banks was lionized on his return with Cook. Wedgwood made a medallion of Banks and his wife, fine studies by Flaxman himself. It resembles the features of Banks as a young man in Reynolds' painting. There is a Wedgwood medallion of Sir Joseph Banks, as a much older man, probably based on a portrait when in his prime, as president of the Royal Society.

Banks visited the Lunar Society, while Wedgwood was a frequent caller, when in London, at 32 Soho Square, where Sir Joseph and Lady Banks kept open house for scientific inquirers. Wedgwood supplied the historic plaque, "The Offering to Flora", symbolic of his regard for Banks as a botanist and founder of the Linnean Society, for the Adam mantelpiece in its library.

Sir Joseph Banks had the services as librarian of Dr. Carl Solander, F.R.S., a pupil of Linnaeus. Solander was responsible for Banks's botanical collection, and was his boon companion on Cook's first voyage, and on Banks's voyage to Iceland. This latter trip was undertaken in 1772, when difficulties arose with the Admiralty concerning his accompanying Cook on his second voyage to the South Seas. It is interesting to note, in passing, that had Banks joined Cook on his second voyage, he would have chosen Priestley to accompany him as official astronomer. But the Board of Longitude, as the Admiralty was then called, showed no "latitude" regarding Priestley's unorthodox religious opinions.

Banks's party to Iceland visited the Western Isles of Scotland. The Isle of Staffa, with its geological interest, was discovered by Banks, and Wedgwood promptly decorated one of his famous Catherine II plates with the Isle of Staffa scene as a tribute to his friends, Banks and Solander. The latter was also engaged by the Dowager Duchess of Portland as her librarian in charge of her rare collection of plants and rare antique vases. Among the latter was the now famous Barberini vase, which Wedgwood reproduced so perfectly in pottery.

In dismissing the many-sided connexions of Wedgwood with these three world voyages to the Antipodes, it will be interesting to study the famous Sydney Cove medallion specially executed by Wedgwood in 1789 to commemorate the founding of Sydney in 1788. It was made from clays from Sydney Cove, originally obtained through the good services of Sir Joseph Banks from Captain Phillip, first Governor of New South Wales. The subject of the medallion is "Hope addressing Peace and Plenty, Art and Labour". The medallion inspired Dr. Erasmus Darwin to poetry in his "Botanic Garden".

Dr. Erasmus Darwin, the poetical and philosophical physician of Lichfield, was the subject of one of the finest portrait medallions in the group of Staffordshire fellows of the Royal Society. By his side is Dr. Johnson, his one-time fellow-resident of Lichfield. At one of the famous meetings of these two Staffordshire literary giants, Darwin, who stammered badly, was asked by Johnson: "Don't you find it very inconvenient stammering, Dr. Darwin?" "No, sir," replied Darwin, "because I have time to think before I speak and I don't ask impertinent questions."

Two Staffordshire peers figure among Wedgwood's portraits: Admiral Lord Anson, who circumnavigated the world in 1744, and was a neighbour of Wedgwood, as also was the Marquis of Stafford, better known as Earl Gower, and the illustrious ancestor of the present Duke of Sutherland.

Leaving these Staffordshire celebrities, we can study a few of the medical fellows of the Royal Society, who are portrayed in the medallions. Many of them were leading lights of the Royal College of Physicians. Among those of whom medallions were made by Wedgwood were John Woodward, famous as a geologist, Henry Pemberton, a physician employed by Newton to superintend the third edition of the "Principia" in 1726, and John Freind, brother of the equally famous Robert Freind, headmaster of Westminster School. The former was physician to Queen Caroline. Two other notable men were Dr. Ingenhousz and Dr. Peter Camper, both of whom were guest lecturers to the Lunar Society. Wedgwood made a fine medallion by Flaxman of Dr. John Fothergill, reputed to have had one of the finest botanical gardens in Europe. Another fine but smaller medallion is that of Richard Mead, physician to George I., Sir Isaac Newton and Sir Robert Walpole.

Two very interesting medallions depict the secretaries of the learned societies of which Wedgwood was a fellow; one is of William Stukeley, secretary of the Society of Antiquaries, the other is of Samuel Horsley, secretary of the Royal Society, who later became the Bishop of St. Asaph. It is a proof of Wedgwood's impartiality in the choice of subjects for his medallions that Horsley, who led the abusive personal attack on Sir Joseph Banks, when president of the Royal Society, is included in his collection. Not unconnected with this incident was the violent and protracted attack on another of Wedgwood's personal friends, Priestley, by the virulent pen of this politically minded prelate. He personally attacked Priestley and his views in his famous

theological work, entitled "Seventeen Letters to Dr. Priestley". In his fight with Banks, this pugnacious priest was completely routed, along with his second, Prof. Charles Hutton, who had to beat a hasty retreat in their assault on the august and dignified president of the Royal Society.

Artistic and Literary Fellows of the Royal Society

One of the foremost of these was Sir Joshua Reynolds, P.R.A., the most famous British artist of the eighteenth century, if not of all time. He was a personal friend of Banks and Wedgwood, both of whom he painted from life. The Wedgwood portrait medallion of Sir Joshua Reynolds is by Flaxman, who also modelled Reynolds' intimate friend Warren Hastings.

Another personal friend of Sir Joseph Banks was Thomas Pennant, the antiquary and naturalist, and author of the famous books "Tours in Wales" and "Tours in Scotland". He was a constant companion of Banks and Solander on their botanical excursions through Wales, a favourite haunt of Wedgwood also.

Last but not least famous in this group was Edward Gibbon, the author of "The Decline and Fall of the Roman Empire". It is from Gibbon that we have a pen picture of Sir Benjamin Thompson, later known as Count Rumford, the founder of the Royal Institution. In a letter to Lord Sheffield, dated September 17, 1783, writing before a vile crossing which he had to France from Dover, Gibbon says: "Last night the wind was so high that the vessel could not stir from the harbour. . . . What a cursed thing to live in an island! . . . The triumvirate of this memorable embarkation will consist of the Grand Gibbon, Henry Laurens . . . and *Mr. Secretary, Colonel, Admiral, Philosopher Thompson*, attended by three horses, who are not the most agreeable fellow-passengers" (italics mine).

I have been unable to trace any Wedgwood portrait medallion of the illustrious founder of the Royal Institution. The explanation is quite simple. Wedgwood discovered that Sir Benjamin Thompson had sat for his portrait to James Tassie, who made several paste medallion portraits of him. A magnificent Tassie medallion of Count Rumford is in the possession of the Royal Institution. Maximilian, the Elector of Bavaria, the patron of Count Rumford, is the subject of another interesting Wedgwood medallion.

My search for a medallion of Sir Humphry Davy has been a barren one. Both Count Rumford and Davy, of course, were connected with the Royal Institution long after the death of Wedgwood in 1795, although Josiah had met young Davy in Cornwall on one of his many visits there Through his sons Josiah and Thomas, in later years. Wedgwood had close connexion with Humphry Davy and the work of the Royal Institution.

Josiah Wedgwood Passes the Torch of Science to his Descendants

Wedgwood's youngest son Tom is recognized as the father of photography. He was in his way a remarkable scientist and chemist. He had studied at the University of Edinburgh, but through chronic ill-health he had to retire from active business. After this he endeavoured to seek health and strength, through travel and association with cultured persons, among whom were counted Coleridge, Southey, Poole and Davy.

Tom Wedgwood, in an indirect way, was responsible for the training and early discovery of Humphry Davy. Count Rumford found Davy installed at the Pneumatic Institution of Dr. Beddoes at Clifton, but it was Tom Wedgwood who made a donation of £1,000 to enable Beddoes to establish his Institution and employ Davy as an assistant. When Davy was later engaged at the Royal Institution as a lecturer and professor, he became a firm friend of Tom Wedgwood. The elder Josiah Wedgwood had also contributed substantially towards the erection of the Pneumatic Institution, in which his friends Darwin, Watt and Dr. James Black had such faith, because of the enthusiasm of Beddoes. Davy recorded in the *Journal of the Royal Institution* (1, 171, 1802) some of the chemical experiments of Tom Wedgwood. The paper was entitled: "An Account of a Method of Copying Paintings upon Glass and of making Profiles by the agency of Light upon Nitrate of Silver. Invented by T. Wedgwood. With observations by H. Davy."

The female descendants of Josiah Wedgwood made their due contribution to science. Susannah ("Sukie") Wedgwood, a favourite of her father, married Robert Waring Darwin, the son of Erasmus Darwin.

The Wedgwood-Darwin pedigree shows the contribution to the realms of science made by these two illustrious families. The issue from this first Darwin-Wedgwood marriage gave to the nineteenth century no other than Charles Robert Darwin. He further embraced the Wedgwood family by marrying his cousin Emma, the daughter of the second Josiah Wedgwood. The fertile mind of Charles Darwin showed that in the nineteenth century he had inherited the remarkable scientific spirit and genius of his two grandfathers, both outstanding eighteenth century philosophers. The descendants of the Prince of Potters have preserved the remarkably fine features of their

illustrious ancestor Charles Robert Darwin in a fine plaque which now hangs in his room in Christ's College, Cambridge.

In conclusion, may I apply to the Prince of Potters who has inspired this discourse, words once spoken of Sir Humphry Davy by Samuel Taylor Coleridge, Thomas Wedgwood's bosom friend, who said: "If Davy had not been the first Chemist, he would have been the first Poet of his Age." We can equally declare: "If Josiah Wedgwood had not been the first Potter, he would have been the first Scientist of his Age."

Obituary Notices

Prof. Victor Grégoire

THE death of Prof. Victor Grégoire on December 12 removes one who was not only a leader among the cytologists of his time but was also one who, as a botanist, was deeply concerned with problems of plant morphology and applied essentially cytological methods to their solution. Especially in the pre-War period, his influence in cytology was wide and many of his contributions were of fundamental importance. He was essentially an observer rather than a theorist, and although many of his best observations were on chromosome structure and behaviour he did not follow cytology far into its later intimate relations with genetics, although his pupil and colleague, Janssens, was the founder of the theory of chiasmata.

In more recent years, Grégoire became deeply immersed in problems of floral morphology, and an extensive memoir on the carpel (*La Cellule*, **47**, part 3) which is the result of ten years of research, has recently appeared. This was intended to be the first of a series of contributions setting forth his views, based on extensive investigations of floral structures.

Grégoire was born at Anderlues, Belgium, on December 5, 1870. From 1887 until 1894 he studied philosophy and theology in Rome. The following year he returned to Belgium and studied science at Louvain for three years under Carnoy. In 1897 he became assistant in botany and in 1899, after two further years of foreign study, he was appointed extraordinary professor of botany, succeeding to the professorship of cytology and botany at the Carnoy Institute in 1903. The rest of his life was spent as a professor in the Catholic University of Louvain. He always adhered to his priestly robes, and he showed outstanding courage during the occupation of Louvain in the Great War. In 1925, the twenty-fifth anniversary of his professoriate was celebrated and two jubilee volumes of *La Cellule* (of which he became co-editor in 1928) were published. These consisted of contributions from his former students, many of whom had visited his laboratory from foreign countries in Europe and the United States.

Grégoire spoke with great clarity of diction and taught with vigour and enthusiasm. A man of very gentle disposition, he lived a very quiet life in a quaint old house of eighteenth-century Flemish style, completely absorbed in his scientific work. In some respects he might be regarded as the counterpart of Mendel in modern life; but in his view, as expressed in 1925, he limited Mendelian behaviour to varieties and held that specific differences were non-mutational in origin and non-Mendelian in inheritance.

Nearly all the more important publications of Grégoire appeared in *La Cellule*. His first paper (1899) was an extensive memoir on the pollen meiosis in Liliaceæ. He concluded that the spireme thread (peloton) divides first longitudinally into two interlaced threads and then transversely into twelve chromosomes, which are therefore constituted of two longitudinal halves. But this is not the place to enter in any detail into the intricate history of the development of ideas regarding meiosis.

In 1903, in collaboration with his pupil Wygaerts, Grégoire made a careful study of the events of telophase in root-tips as regards the history of the chromosomes and their transformation into the resting nucleus. These papers immediately gave him a deservedly high reputation as an observer. The phenomena of meiosis shortly reclaimed his attention, and a series of memoirs followed until 1916 on various aspects of mitosis and meiosis in plants and animals. Several of these were extensive critiques of the current literature. In 1905 he concluded that if there was a real reduction division of the chromosomes it must be the first division. In 1907 he introduced the term zygotene for the stage in which the threads pair longitudinally to form a thick spireme or pachytene nucleus. (Dr. C. D. Darlington's suggestion in NATURE of February 4, p. 206, that my first paper (1907) was responsible for the conception of the continuous spireme in pollen mother cells is therefore erroneous, because the conception was current if not universal for some years before my work was begun.) By 1910 he had clearly adopted parasynaptic pairing at the zygotene stage as characteristic of meiosis in plants and animals generally.

In the post-War period, Grégoire transferred his main interest to other fields of botany. He published several text-books dealing with general botany, anatomy and the systematics of angiosperms, only once returning to cytology in a paper on chromocentres in plants, although many cytological papers continued to appear from his laboratory.

In recent years, the nature and origin of the carpel has been the subject of much investigation, and many diverse views and theories of its morphology have been propounded. Grégoire's extensive memoir on this subject adds a different view. Having discarded the classical theory of its leaf-like nature, he also

disagrees with all the views recently propounded. He concludes from a detailed comparison of stem-tips and floral receptacles in many plants that the vegetative cone and the floral apex are independent structures, carpels not arising from the latter in the way that leaves arise from the former. He held the view that the carpel, as a reproductive structure, was an organ *sui generis*, not to be homologized with any purely vegetative structure such as a leaf. His work will doubtless lead to further discussion of this intricate problem.

During his relatively uneventful but scientifically active life Grégoire received many honours. He was a member of the Royal Academy of Belgium, the Paris Academy of Sciences, the Pontifical Academy of Sciences and the Royal Irish Academy, and had received honorary degrees from various universities. He was elected a foreign member of the Linnean Society in 1917 and an honorary fellow of the Royal Microscopical Society in 1931.

I am indebted to Profs. Martens, Robyns and McLean Thompson for several of the facts here recorded relative to the life of Grégoire.

R. RUGGLES GATES.

Dr. C. J. Gahan

DR. C. J. GAHAN, who died on January 21, the day after attaining his seventy-seventh birthday, was for thirteen years keeper of the Department of Entomology of the British Museum (Natural History) and was in charge of the enormous collection of insects at South Kensington from 1910, when he succeeded the late Charles Owen Waterhouse as assistant-keeper in charge of that section of the Department of Zoology, until his retirement from the Museum in 1926. Increasing recognition of the importance of entomology led to the creation of a separate Department of Entomology in 1913 and Gahan was appointed its first keeper.

Charles Joseph Gahan was born at Roscrea, Tipperary, in 1862, the son of Michael Gahan, master of Erasmus Smith's School in that town. He was educated first in his father's school and afterwards at Queen's College, Galway (later of the National University of Ireland), from which he obtained the degree of M.A. and afterwards D.Sc. In 1884 he went to London and for two years studied science at the School of Mines (now the Royal College of Science), then presided over by Huxley. In 1896, he was appointed to an assistantship in the Department of Zoology of the British Museum (Natural History), which only six years previously had been removed to South Kensington. Although until that time he had made no special study of insects, his inclination having been chiefly in the direction of botany, it was the rapidly growing entomological collection, and especially the immense order of Coleoptera, to which he was to devote himself during the thirty years spent in the service of the Museum. In 1899 and 1900 he was secretary, and in 1917 and 1918 president, of the Entomological Society of London.

Of Gahan's numerous published writings most are upon the timber-destroying family of beetles, the Cerambycidæ, upon which he became the leading authority. He also devoted considerable attention to the problem of dealing with the depredations of the death-watch beetle and the closely related furniture-beetles, and was the author of a valuable booklet published by the Museum on the subject. Other subjects to which he made original contributions were mimicry in insects and the vocal and auditory organs of the Coleoptera. Although never a keen collector, he was by no means an arm-chair naturalist, but took the greatest delight in the study of living creatures. He was also an enthusiastic horticulturist and, being cut off by persistent ill-health from the means of continuing his former pursuits, he devoted much of the last twelve years of his life to the cultivation of a large garden at Aylsham, in Norfolk, where he lived from the time of his retirement. He leaves five sons and two daughters.

GILBERT J. ARROW.

Prof. M. W. Pavlova

PROF. M. W. PAVLOVA (Marie Pavlow), professor of palæontology in the University of Moscow, died on December 20 at the age of eighty-four years.

A pioneer of the progressive movement among women of old Russia, she was educated abroad. She was a pupil of the French palæontologist Albert Gaudry, and introduced the principles of his school into her native country and trained several generations of Russian palæontologists, particularly women.

After Woldemar Kowalevsky, whose chair she held in the University of Moscow, Marie Pavlow was the founder in Russia of palæontology as a biological science. Full of energy and activity, she frequented the museums of her country and described in her valuable monographs the collections of fossil mammals hidden in these museums. Similar fossils were studied by her abroad in various European and American museums. She was thus able to draw the generalized conclusions in her "Etudes sur l'histoire paléontologique des ongulées" for the various groups of ungulates, namely, horses, rhinoceroses, artiodactyles and proboscids. Having worked a great deal in foreign museums she made friends with the foremost palæontologists of the world. Her name was one of the best known among foreign naturalists.

Marie Pavlow considerably extended the palæontological material left by W. Kowalevsky in the University of Moscow, and together with her husband, the late professor of geology, A. P. Pavlow, created one of the best palæontological museums in the U.S.S.R., which now forms part of the Moscow Geological Institute.

A. BORISSIAK.

WE regret to announce the following deaths:

Dr. L. H. Dudley Buxton, fellow and bursar of Exeter College and reader in physical anthropology in the University of Oxford, on March 5, aged forty-nine years.

Mr. Howard Carter, known for his work in Egyptology, especially in connexion with the tomb of Tutankhamen, on March 2, aged sixty-five years.

News and Views

Prof. E. H. Minns, F.B.A.

PROF. ELLIS HOVELL MINNS will retire shortly from the Disney professorship of archæology in the University of Cambridge, which he has held since 1927, when he succeeded the late Sir William Ridgway. Prof. Minns has been a fellow of Pembroke College, Cambridge, of which he had been an undergraduate, since 1899, and became president in 1928. After taking his degree at Cambridge he studied Oriental languages in Paris, and spent three years in Russia, studying its languages, history, art and antiquities. On his return to Cambridge in 1901 he was appointed librarian and lecturer in Russian in his college, and in 1906 became University lecturer in palæography. As an archæologist he is best known for his pre-eminence as an authority on the peoples and cultures of ancient Scythia, upon which his "Scythians and Greeks", published in 1913, is of outstanding value. His services to this branch of archæological studies was recognized by his election in 1925 as a corresponding member of the Russian Academy for the History of Material Culture. Prof. Minns is a fellow of the British Academy; and during the Great War his linguistic abilities were recognized by his appointment to the censorship of uncommon languages, which he held from 1915 until 1918.

New Autogyro for Army Service

A DEMONSTRATION of vertical take-off and landing by the new type C.40 Autogyro, referred to as the 'jumping gyro', was given recently at the Army Staff College, Camberley. Mr. Brie made several successful take-offs and landings on the Owl's cricket ground, which measures only 150 yards by 100 yards and is almost entirely surrounded by buildings and high trees. In addition to making vertical rises from the ground of 8–10 ft., the machine was put through a series of evolutions in the air illustrating its control and ease of handling in a confined space. The most outstanding of these was an entirely unintentional one at the close of the display, when the pilot, judging that he had not sufficient margin to clear some trees, throttled his engine back and put the machine down almost exactly upon the spot from which he had started. Such a manœuvre would have been impossible with the more conventional type of aeroplane. This display, given on a bad day with intermittent rain causing inevitable air currents and eddies near the ground, is considered to be a much more searching test of the machine's controllability than was the recent test of a direct-lift helicopter made in a big hall in Berlin. Although flying in a building gave an appearance of complete control in a very confined space, actually the steady performance of the machine would be materially helped by the perfect calmness of the air indoors. It is considered that this type of machine will facilitate the work of Army communication by reason of the fact that, requiring practically no horizontal run, it is independent of the condition of the landing surface. Not only will it not need a specially prepared aerodrome, but it should also be able to operate from land where even shelling or bombing has been experienced. It is also obviously suited to operating from the deck of a ship.

Leopold Gmelin and his "Handbuch"

To commemorate the hundred and fiftieth anniversary of the birth of Leopold Gmelin, the Deutsche chemische Gesellschaft has issued a sample booklet with lengthy extracts from the "Handbuch" and an illustrated brochure with Gmelin's portrait and historical notes on the growth of this monumental treatise. Gmelin belonged to an ancient Swabian family of apothecaries established in the seventeenth century at Tübingen, where his grandfather held the University chair of chemistry, one of the oldest in Germany. His father became professor of botany and chemistry at Göttingen, where Leopold was born on August 2, 1788. After graduating in the faculty of Medicine at Göttingen, he studied chemistry at Tübingen and in Vienna. Later he travelled in Italy, where he interested himself in the geology of the volcanic rocks, but his chief interest lay in chemistry, and he decided to complete his training in Vauquelin's laboratory in Paris and at the same time make personal contacts with Gay-Lussac, Thenard and Haüy. In 1817, he was appointed to the chair of chemistry at Heidelberg, where he began to write his treatise, the first edition appearing in three volumes in 1817. It met with immediate success, and several editions had to follow. In 1830, Berzelius praised it in glowing terms. The fourth edition was translated into English by the Cavendish Society in 1846, and included organic chemistry for the last time. Gmelin was occupied with the organic part until his death in 1853. The eighth edition, begun in 1922, is at present being compiled by no fewer than seventy experts, who expect to finish their task by 1943 and to secure a lasting future for this valuable documentation. Both the sample booklet and the brochure may be obtained free on application to the Gmelin-Redaktion, Berlin W.35, Tiergartenstrasse 10.

Ornithological Library for Australia

IT has recently been announced that Mr. G. M. Mathews has presented his ornithological library to the Commonwealth of Australia, and that it will be housed in the National Library at Canberra. Mr. Mathews, who is the author of twelve large volumes on the "Birds of Australia", has been collecting books on ornithology for the last forty years, and his library consists of some four thousand works and pamphlets. Although many ornithologists may not agree with Mr. Mathews' systematic work as a whole, all will admit that he has done more than anyone to elucidate the early history of ornithology in Australia. He has

specialized in the works of early voyagers to the southern hemisphere in which there is any mention of birds, and his collection includes a copy of that very rare book published in 1701 by William de Vlaming, a "Journal of a Voyage to the Unexplored Southland . . . in 1696 and 1697". Of books on Australian birds, there is a complete set of all the editions of Lewin's "Birds of New Holland", starting with the first, published in 1808, of which there are only six known copies. Gould's great folio work is of special interest, since it includes the two parts published before the author went to Australia and afterwards withdrawn and replaced, after his return.

SINCE Mr. Mathews takes a great interest in nomenclature, his library naturally includes many rare and little-known general works. Among these may be mentioned Vroeg's "Catalogue" (1764), and Boddaert's "Table des Planches Enluminées" (1783), the former not included in the British Museum's (Natural History) library, and the latter only represented by a photostat copy and a reprint. Other rare and interesting books include Rafinesque's works (1814–22), Berthold's edition of "Natürliche Familien des Thierreich" by Latreille (1827), and Moehring's "Avium Genera" (1752). There are complete sets of certain periodicals such as the *Isis*, and more particularly of local journals published in Australia, including the first volume of the Queensland Philosophical Society, which is said to be unique. After having completed his "Birds of Australia", Mr. Mathews brought out an additional volume of bibliography, and, with a few exceptions, all the books mentioned therein are in his possession. The acquisition of this library should now enable students in Australia to study ornithology independently of the libraries in Europe and elsewhere.

Nutritional and Allied Aspects of Milk

IT has already been announced that the new Division for the Social and International Relations of Science of the British Association is arranging a meeting for the discussion of this subject to be held on March 28 at the University of Reading. Representatives of a number of interested public bodies and institutions will be present. The meeting will be divided into two sessions, lasting from 2.15 to 4.15 and from 5.15 to 7.0, with an interval for tea. At the first session the chair will be taken by Sir Richard Gregory, chairman of the Division. Dr. Harriette Chick will open the discussion, dealing with deficiencies in present-day diet, the total amount of milk needed, etc., Prof. J. C. Drummond will discuss health aspects, and Dr. A. W. Scott will speak on the implications of compulsory pasteurization. At the second session, Sir Daniel Hall will be in the chair. Mr. J. MacKintosh will discuss agricultural aspects of milk production, with special reference to increase of production, and Mr. J. Cripps will speak on the distribution, cost and the economic and social implications allied with the subject. The meeting will be preceded, in the morning, by a visit to the National Institute for Research in Dairying at Shinfield, near Reading. Arrangements will be made for lunch, tea and dinner to be served in the University so far as accommodation permits, and accommodation for the night preceding the meeting may be arranged if a sufficient number desire it. Admission will be free, by ticket. A limited number of tickets will be obtainable from the Secretary, British Association, Burlington House, London, W.1.

The Institute of Chemistry

AT the sixty-first annual general meeting of the Institute of Chemistry held on March 1, Sir Robert Pickard, the retiring president, directed attention to the fact that the membership now consists of more than 7,200 qualified chemists. The Council is endeavouring to obtain the consent of the fellows and associates to a petition for a supplemental charter embodying a scheme for the registration of those chemists whose qualifications are the same as those required for admission to the Institute, but who do not wish to become fully associated with its work. It is, in Sir Robert's view, a scheme proposed in the best interests of the Institute, of the profession as a whole, and of the State. Sir Robert referred to the possible utilization of the services of chemists in any national emergency. The position of the country, so far as the supply of chemists and the condition of the chemical industries are concerned, is very different from that of twenty-five years ago; but war usually brings unexpected demands, and chemists will be glad to know that an organized effort is being made which will direct their skill and willingness to serve the country into the most advantageous channels. The Institute is fortunate that, in times like the present, less than 1·2 per cent of its members are known to be without employment, and only a small proportion of those has been unemployed for any long period. Sir Robert directed attention to the third annual report of the Chemical Council, recently published. This body, on which the Institute is represented, has under consideration a scheme the object of which is to distribute the burden of the cost of publications of the Chemical Society and the Society of Chemical Industry more equitably over the membership of all three chartered chemical bodies. The Meldola Medal, the gift of the Society of Maccabæans, has been awarded to Dr. William Charles Price. The following officers for 1939–40 have been elected: *President*, Mr. W. A. S. Calder; *Vice-Presidents*, Dr. H. V. A. Briscoe, Dr. F. H. Carr, Dr. T. P. Hilditch, Mr. G. Roche Lynch, Dr. C. Ainsworth Mitchell, and Sir Robert Pickard; *Hon. Treasurer*, Mr. B. F. Howard.

Society of Public Analysts and Other Analytical Chemists

AT the annual general meeting of the Society of Public Analysts and Other Analytical Chemists held on March 3, the following officers were elected for the year 1939–40: *President*, Prof. W. H. Roberts; *Vice-Presidents*, E. B. Anderson, J. R. Nicholls, W. H. Simmons, T. P. Hilditch (chairman, North of England Section), T. Cockburn (chairman, Scottish Section); *Hon. Treasurer*, E. B. Hughes; *Hon. Secretary*, Lewis Eynon. Following the annual

general meeting, a lecture was delivered by Sir Henry Dale on "Biological Standardization". Sir Henry outlined the history of the establishment of standards for the biological assay of preparations of physiologically active products such as antitoxins, hormones, vitamins, etc. Attempts to set up units in terms of physiological effects under particular experimental conditions ('rat units', 'mouse units', etc.) have led to wide discrepancies and great confusion, owing largely to the difficulty of reproducing the conditions under which the proposed units were first determined. Following the pioneer work of Paul Ehrlich, the systematic establishment of international 'units of activity' based on stable standard preparations of the active substances was begun under the auspices of the Health Organisation of the League of Nations in 1921, and a number of these standards have been prepared at the State Serum Institute, Copenhagen. Standards for a still larger number of products have more recently been prepared in Great Britain at the National Institute for Medical Research, Hampstead. A general account was given on these developments and some particulars of the standard preparations now available.

A Bird-watcher's Experiences

IN a lecture to the University of London Animal Welfare Society, at Bedford College on March 8, Mr. Eric Hardy, of the British Empire Naturalists' Association, spoke of his experiences as a bird-watcher in various parts of Great Britain. He mentioned how a day-by-day census and survey of the sparrow population of the Liverpool Cathedral Birds' Sanctuary, in the heart of city slums eight miles from open country, failed to prove any great migration out of the city to country harvest fields as is often supposed, although many other migrants, chiefly warblers, passing over the city, use the sanctuary as a resting-place. This famous little sanctuary is to be reconstructed and re-equipped this year by the Merseyside Branch of the British Empire Naturalists' Association, which will be its custodian in the future. Mr. Hardy gave his experiences of the increasing numbers of buzzards and ravens in Wales, how swifts and tawny owls are among the birds adapting themselves to life in growing towns, even in the industrial north. The annual May shooting of baby rooks in the nest is a cruel sport, he said, and even apart from that question, field-studies show that unless rooks are in abnormal numbers, they do more good than harm on the land. The habit of taking regular censuses of bird numbers in various areas has added considerably to our knowledge of bird movements and migrations, especially with shore birds.

Archæological Excavations in Cornwall

RELICS obtained from excavations on a Late Bronze and Iron Age site in the Great Gear Field at Carwarthen, St. Just-in-Roseland, Cornwall, are now on exhibition in the museum of the Royal Cornwall Polytechnic Society at Falmouth. These excavations have been carried out during the past year under the direction of Mr. S. A. Opie of Redruth. The site, it would appear from an account of the excavations in the *Royal Cornwall Gazette and County News* of February 22, was occupied from 1000 B.C. onward. In the earlier phases of its occupation, it is the first to be identified in Cornwall as dating from the important Late Bronze Age period, to which belong the earliest classical references to the Western tin trade. The site is thus of unusual interest and importance; while in view of the small area as yet explored, it is the richest and most productive of the period of its later occupation as yet examined in Cornwall. A fair amount of bronze age pottery, some with cordon and finger-tip impressions, has been recovered; but as yet no traces of structural remains of the early period have been found. A small circular fortification belongs to a later occupation, being of a usual iron age type. Of this, the position of the circular ditch has been established at six points where it is from six to ten feet deep. Stone revetments of the inner face of the ditch have been found at five points. The ramparts, much damaged by ploughing, afford evidence of several periods of construction. At the best preserved section, there are three successive stone revetments, and clear evidence of an interior wall walk. The iron age pottery is mostly late, being attributed to the first century A.D. or at oldest to the first century B.C. None of the fine decorated pottery of the second century B.C., such as has been found at Glastonbury or Castle Dore, has appeared. The site was extensively occupied in Roman times down to the fourth century. Native pottery betrays Roman influence, while two pieces of Samian of the second century A.D. and two of New Forest wares of the fourth century A.D. have been unearthed. Coins, numerous fragments of iron implements, perforated slate disks and a waisted stone hammer have also been found. The excavations are to be continued.

Electric Generators at Boulder Dam

DURING 1938, *Engineering* published a series of articles dealing with the remarkable work being carried out at Boulder Dam, Arizona. This project has a three-fold purpose—flood control, storage of water for irrigation and domestic and industrial use, and the generation of electric power. There are two power-houses, the Nevada wing and the Arizona wing, and the series of articles referred to is brought to a close by a description of the electrical equipment being installed in these. The two articles on this subject are by Mr. L. N. McClellan, and were published in *Engineering* for February 10 and 24. There will ultimately be eight large units of 82,500 k.v.a. in the Nevada wing and seven similar units and two units of 40,000 k.v.a. in the Arizona wing; the hydraulic turbines driving the larger units being of 115,000 h.p. Each of the 82,500 k.v.a. generators is 40 ft. in diameter, 32 ft. in height above ground-level and weighs approximately 900 long tons. The stator frames are constructed entirely of steel plates and structural shapes electrically welded together. The rotors are 25 ft. in diameter, 8 ft. deep at the rim, and are carried in shafts 38 in. in diameter and

36 ft. long. Each weighs approximately 580 tons. One group of machines will furnish power for the pumping plants on the Colorado River, supplying the Metropolitan Water District, a second group will supply the cities of Los Angeles, Burbank, Glendale and Pasadena, a third the Southern California Edison Company, and a fourth will supply power to the States of Arizona and Nevada. With the service station generators the ultimate capacity of the plant will be 1,323,500 k.v.a.

The *Indian Journal of Pharmacy*

SCIENCE has proceeded apace in India, especially since the Great War, and this progress has been marked improvement in India's scientific publications and the initiation of new journals of international importance. Now, we are pleased to welcome another addition to the list, namely, the *Indian Journal of Pharmacy*, the official publication of the United Provinces Pharmaceutical Association (1, No. 1, Jan.–March, 1939. The Secretary, U.P. Pharmaceutical Association, Department of Pharmaceutics, Benares Hindu University. Rs. 3*s*., India; Rs. 4*s*. abroad annually). The *Journal* is being edited by Prof. M. L. Schroff with the help of a strong editorial board. It has a format similar to that of most other Indian scientific periodicals, and this number contains fifty pages. It opens with an editorial explaining the aims of the U.P. Pharmaceutical Association and its *Journal*, which leads on to a review of pharmacy in other countries. Then follows an article on "Diet in Relation to Copper for Infants" by Dr. U. P. Basu; another specialized article, by Prof. M. L. Schroff and M. Lal Dhir, deals with the "Assay of Kurchi and Kurchi-Bismuth-Iodide". More general articles deal with the medicinal, aromatic and allied plants of Egypt, the medicinal plants of Kashmir and the treatment of burns. Notes and news, abstracts, reviews and proceedings of the Association complete the number. It would be ungracious to point out ordinary slips in the printing of the *Journal*, but the typography might well be improved. We sympathize with the *Journal's* plea for the establishment of an Indian Pharmacopœia.

An Educational Co-operative Colony

ON the initiative of Sir Akbar Hydari, the Chancellor of the Osmania University and President o the State Council, Hyderabad (Deccan), an attempt is being made to demonstrate the suitability for adoption on a large scale of a plan for part-time education in association with co-operative production for use. This enterprise is being conducted under the auspices of the Hyderabad State Co-operative Department and is under the management of Captain J. W. Petavel, who has for many years devoted his energies to the advocacy of similar schemes in connexion with the University of Calcutta propaganda inaugurated by the late Sir Asutosh Mookerjee for educational colonies. For the new scheme, buildings and twelve acres of land belonging to the Osmania University have been made available, and it is hoped that undergraduates will take advantage of the opportunity to train for educational colonies work. It is intended to establish another and much larger colony in an irrigated tract. The general idea of the educational colony is to form the children and adolescents for educative employment in colonies organized for co-ordinated production of food and other necessaries of life. The child's day would be divided between "really good production work, good games and class work" in approximately equal shares. Special features of the new scheme are to be: employment of well-trained adolescents under the guidance of a few adults to supervise the children, co-operation between capitalists and workers for production for use, and an extensive use of labour-saving methods.

Earthquake in the Solomon Islands

AN earthquake of sufficient intensity to affect seismographs in all parts of the world occurred on January 30 at 2h. 18m. 31s. G.C.T. No news of any earthquake damage was reported from any place at this time, and by instrumental records from thirty-two stations alone E. Peterschmitt, at Strasbourg, has determined a provisional epicentre at latitude 6° S., longitude 156° E. This is near the Solomon Islands, a well-known seismic centre. It was from an epicentre to the south-east of this, namely, 9° S., 159·5° E., that a very severe earthquake occurred on January 25, 1926, ruining the catholic church at Visale, doing very severe damage to property and causing severe casualties. In October 1931, again, earthquakes with epicentres 14° S., 160° E., and 8° S., 160° E., did severe damage on several islands. At San Cristoval two villages were razed by the first earthquake and eighteen villages on the southern coast were afterwards swept away by a sea wave 30–40 ft. high. For the 1939 shock the seismogram at Stuttgart included e_zP, 2h. 34m. 24s., i_zP', 2h. 37m. 39s., (dilatation), *iPKS*, 2h. 41m. 2s.; *eL*, 3h. 16m. (T = 50s.); *MQ*, 3h. 26·5m. (T = 22s.) and *MR*, 3h. 38·5m. (T = 20s.) all in G.C.T.

Central and South American Earthquakes

ON the basis of reports from the seismographic stations at Georgetown, Fordham, Huancayo and San Juan, the U.S. Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of February 9, 1939, at 15h. 30·5m. G.C.T. to be provisionally latitude 11·5° N., longitude 88° W. This epicentre is in the Pacific Ocean to the west-south-west of Managua, the capital of Nicaragua, which was almost completely destroyed in the earthquake of March 31, 1931. The epicentre nearest to the present one in recent years was on February 15, 1926, when the epicentre was 11·7° N., 89·6° W. No damage has been reported in the present instance. Following recent shocks, the town of Cumbaya, near Quito, was strongly shaken during the night of March 2, by an earthquake which cracked many buildings, and caused apprehension amongst the inhabitants. No casualties are reported. It was on February 7, 1797, that Quito was destroyed by earthquake with the loss of 40,000 lives. On

October 2, 1933, another part of Ecuador, namely, the Santa Elena Peninsula, was strongly shaken by an earthquake. Weak local shocks often occur in the area.

Michael Scot: Pioneer of Science

PROF. J. READ has contributed an interesting study of "Michael Scot: a Scottish Pioneer of Science" to *Scientia* (Oct.–Nov. 1938). Michael Scot lived in the early part of the thirteenth century and worked as a translator of Arabic writings in Spain and Sicily, where he was court astrologer and philosopher to the Emperor Frederick II. In later times he acquired the reputation of a magician and necromancer, and many legends have gathered around his name. Although our knowledge of him is fragmentary, Prof. Read shows that Michael Scot was a man of genuine scientific interests. His views on alchemy are interesting, since it is significant that he mentions neither transmutation nor the philosopher's stone, so that he followed the Greek-Egyptian sources rather than the later authors of western Europe. Of his other works, Scot's "Physionomia" had an extensive circulation in manuscript for 250 years and afterwards in several printed editions. He also wrote on astronomy, astrology and the art of prediction, and stands out as the most eminent Briton to secure a place in the history of medieval Italy.

The Imperial Institute

THE annual report of the Imperial Institute (South Kensington, London, S.W.7) for 1938 shows that an important side of the work of the Institute lies in the research departments which answer an increasing number of inquiries from all parts of the Empire. Queries concern both seeds and roots of economic value and various mineral samples. The Mineral Resources Department was particularly active and reported on samples from various colonies. Special interest attaches to the demand for high grade quartz crystals for both piezo-electric and optical purposes, but so far the search for new sources of this material has had little success. The oxide of titanium known as rutile which is used in the coating of electric welding rods has been found in various parts of the Empire. Many other examples of the usefulness of the Institute are recorded in this report.

A Virus Disease of the Elm

AMERICAN elm trees in the Ohio valley are subject to a new and deadly virus disease which is briefly described in a mail report from Science Service, Washington (Feb. 4, 1939). Leaves upon infected trees first shrivel and become brittle, then the roots and inner bark of the trunk rot away, and the tree dies within a few months. This is the first known instance where a virus disease has caused a fatal epidemic among trees. The outbreak appears to be even more serious than that of the so-called Dutch elm disease which has decimated elm trees in the neighbourhood of New York. It is reported that more than 1,000 out of about 1,800 elms in one particular locality have been killed by the virus during three years. Means of dissemination of the pathogene have not yet been found, but the United States Division of Forest Pathology is taking energetic measures to trace the extent of the infection, and to limit it to one district, if possible.

Use of Electricity in Coal Mines

ON the recommendation of the Royal Commission on Safety in Coal Mines, the Secretary for Mines has appointed a Committee with the following terms of reference: "To be a committee to consider, in the light of experience and modern practice, what amendments are required in the General Regulations governing the use of electricity below ground and above ground at mines under the Coal Mines Act, 1911, taking into consideration the report of the Royal Commission on Safety in Coal Mines and the evidence on the subject submitted to that Commission". The following are members of the Committee: Prof. W. Cramp, Department of Electrical Engineering, University of Birmingham (chairman); Mr. J. A. B. Horsley, H.M. Electrical Inspector of Mines; Mr. A. M. Bell and Mr. A. B. Connell. The secretary to the Committee is Mr. R. Crawford, Mines Department, Mill House, 87–89 Shaftesbury Avenue, London, W.1.

Chemical Society Anniversary Meetings

THE anniversary meetings of the Chemical Society this year are to take place in London on March 29–31. On March 29 the Rutherford Memorial Lecture will be delivered by Sir Henry T. Tizard at the Royal Institution at 5 p.m., and fellows and guests will be entertained at a reception and dance at Imperial Chemical House from 8.45 until midnight. On Thursday, March 30, visits have been arranged in the morning to Bedford College for Women and to the Wellcome Research Institution, to view the laboratories and museums. The annual general meeting will be held at Burlington House at 2.30 p.m., and at 4 p.m. the presentation of the Longstaff Medal and of the Harrison Memorial Prize will be made and Prof. F. G. Donnan will give his presidential address. The anniversary dinner of the Society will be held at Grosvenor House the same evening at 7 for 7.30 p.m. On Friday, March 31, visits have been arranged in the morning to The British Drug Houses, Ltd., and to the Central Laboratories of the Shell Marketing Co., Ltd., and in the afternoon to the Research and Development Department of the Distillers' Company, Ltd. at Epsom, and to the laboratories of the Research Association of British Paint, Colour, and Varnish Manufacturers.

Royal Society of Edinburgh: Elections

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 6, the following ordinary fellows were elected: Prof. Arthur B. P. Amies, Australian College of Dentistry, Melbourne; Dr. William G. Annan, Clinical Medical Officer, Durham County Council, Darlington; Prof. J. H. Baxter, Department of Ecclesiastical History, University of

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NATURE

SUPPLEMENT

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REVIEWS

Arthur Young, F.R.S.: Farmer

Sheep and Turnips

Being the Life and Times of Arthur Young, F.R.S., First Secretary to the Board of Agriculture. By Amelia Defries. Pp. xviii + 235. (London: Methuen and Co., Ltd., 1938.) 7*s*. 6*d*. net.

ANALOGIES between the agricultural conditions in the later years of the eighteenth century and those of to-day render opportune the publication of this study of Arthur Young. Agriculture at both periods was depressed. Countrymen were flocking to the towns, and the land was being neglected and allowed to become derelict. A revolution in farming practice, coupled with the introduction of new crops, is to be contrasted with possible methods to-day, very different in that no new bulk-feed or other crops are being advocated. There was a fight to combat the food-shortage and high taxes of the Napoleonic period, as there was in the Great War—and must be in all future wars. The enclosure of lands—twenty-two million acres during Young's period—allowed the development of arable farming for corn, while the growth of winter feed, especially turnips, encouraged the carrying over of stock from year to year and eliminated salt meat from our dietary. The introduction of cabbage, the popularization of potatoes and the regular use of clover assisted in producing an alternation of crops and were thus of importance. To-day, in contrast, we have a huge manufacturing population to be fed, while much land has gone out of cultivation, and many farms show increasingly depleted and weedy soils which only an evolution in scientific practice or a revolution in the attitude of the State can rectify.

The change-over of the eighteenth century was mainly due to three men, Coke, Sinclair and Young, aided by the interest of King (Farmer) George. Coke carried out vast enterprises in Norfolk with financial success; coupled with these was a great improvement in the social life of his region, enclosure and high farming increasing its population threefold. Sinclair opened up his large estate in Scotland by roads, enclosing where he could—and statistically examined his country's agriculture in respect to population.

Young, born in 1741, son of a Suffolk vicar, who was also a fashionable clergyman in London, being chaplain to the Speaker, was the dominant influence. His mother was a Jewess. His 'polite' education was scanty, the extravagance of his father temporarily reducing him to the lower social grade of a farmer. By his pamphlets, often political, he procured money to buy books and soon took charge of one of his mother's farms in Suffolk. After four years, he recounted his experiences in a series of "Farmer's Letters to the People of England", also meditating on the ways to harmonize agriculture and manufacture. "What vast employment the Enclosing gives . . . constantly keeping fences, ditches, gates, styles, bridges, in order, and . . . converting the wastes into arable farms . . . the numbers requisite for tillage . . . the numbers of manufactures . . . hides increasing amazingly . . . causing cheapness of bread".

In the next five years, Young published "Farmer's Tours through the South, North and East of England", meantime cultivating a new farm which showed little profit as it was used for thousands of experiments. He was ever in want of money, though at times his writing, at ten shillings a page, was considerable—later as farmer-journalist to the *Morning Post* at five guineas a week. His fame was growing, and in 1774 he was elected to the Royal Society. As a diversion, he made a highly successful Irish tour. A legacy relieved him, and he commenced his great undertaking, "The Annals of Agriculture", to which that

great "Briton"—he coined the word—Ralph Robinson (Geo. III) contributed, advocating clover, turnips and rye as fallow crops, more than paid for by the dung of the cattle which fed on them. Then in 1787–89 succeeded a series of French tours in two volumes, which with all his works was published by the Directory in twenty volumes, these forming the basis for all subsequent agriculture in France. Young was now famous, the revolutionist-reviver of land prosperity, and his methods were being universally studied. George Washington was his regular correspondent, and the Empress Catharine sought his advice. In 1793, Pitt created the Board of Agriculture of which Young became secretary, thereafter to be concerned mainly with the provision of food in times of war. He died in 1820, this father of modern agriculture, still a poor man, blind but happy in the revival that farming was showing after twenty terrible years.

Historians (Trevelyan, Green and Rose) pay high tribute to this great Englishman—he was also the founder of the Yeomanry—but we are rather concerned with his methods. That Humphry Davy was appointed by him to lecture on "The Connection of Chemistry with Vegetable Physiology", the following year becoming professor of chemistry to the Board, is indicative of his views. His experiments on the use of turnips, potatoes, carrots, onions, etc., were numerous, and he introduced chicory and "nursed" the cabbage. He was all this time trying out rotations of crops in relation to soils, also the production of manuring by natural methods *per* head of stock. There are studies on soils, the absorbing properties of earths and the considerations of air in the soil. All experimentation, even if of no immediate practical value, is "necessarily useful . . . a spur that instigates abler heads. . . ." Enough of this charming personage, a great writer and thinker, student of the world, its society, its politics, its pleasures and its pains. A story to be recommended for our shelves.

J. S. GARDINER.

Air Raid Precautions

(1) A.R.P.
By J. B. S. Haldane. Pp. 296. (London : Victor Gollancz, Ltd., 1938.) 7*s*. 6*d*. net.

(2) Air Raid
The Technique of Silent Approach ; High Explosive ; Panic. By John Langdon-Davies. Pp. 142 + 32 plates. (London : George Routledge and Sons, Ltd., 1938.) 2*s*. 6*d*. net.

(3) Report of the Committee of the Institution of Structural Engineers on Air Raid Precautions
Pp. 48. (I.S.E., 1938.) 1*s*.

(4) A.R.P.
A Report on the Design, Equipment and Cost of Air-Raid Shelters. (Reprinted from *The Architects' Journal* for July 7, 1938.) Second edition. Pp. 15–48. (London : Association of Architects, Surveyors and Technical Assistants, 1938.) 1*s*.

THE disastrous effect of the gas attacks by Italian aircraft on the defenceless Abyssinians made such a profound impression on the equally unprepared people of Britain that the first air raid precautions in this country were heavily biased towards anti-gas measures. Then Japanese incendiary bombs on the inflammable areas of Chinese cities emphasized the importance of the fire-fighting services. But it is only recently that the deadliness of high explosive, as exemplified in Spain, is being given its due weight. That this should be so seems strange, as there are still many men in England who have had first-hand knowledge of high explosive shells. A bomb only differs from a shell in that, weight for weight, it contains a greater percentage of explosive, and a heavy howitzer shell comes down from a height equal to that of Mount Everest. Given gas masks, the men who have faced it would infinitely prefer an attack by gas to one of equivalent weight of high explosive. For this reason, these two books, which deal with the general question of A.R.P. and the effect of high explosives in Spain, and the two professional reports on practical measures of protection, come as a useful corrective to our first obsessions.

(1) As might be expected from a man of his eminence, Prof. J. B. S. Haldane's is a masterly book, marred perhaps for some people by the political ingredient mixed with the main theme; and at times unworthy of his high level, as when jeers are made at the Home Office for its alleged solicitude for the pekes of Berkeley Square because in the "Householders' Handbook" people were advised to remove their pets. But whatever political opinions we hold, it is a book well worth reading. Clear, intensely interesting and with much of practical value.

On the subject of gas and bacteria, Prof. Haldane is reassuring. Most of the possible types of organic

compounds with small molecules have already been made. Mustard gas was discovered in 1886 and nothing worse had been produced by 1918. Since a poison gas must have small molecules, it is unlikely that more effective poison gases will be found. In theory, microbes might be used, but their general application is well-nigh impracticable and their use would probably be limited to producing panic fostered by rumour. With regard to the effect of gas, the casualties in the Hamburg disaster of 1928 are illuminating. A tank containing eleven tons of phosgene, one of the most deadly of war gases, burst without warning on a totally unprepared and unprotected population. Ten people were killed and about fifty made seriously ill. Prof. Haldane calculates that high explosives would be perhaps fifty times more deadly than gas. He therefore strongly advocates deep tunnels and shelters for the whole population of the target cities, at the huge cost of £400,000,000, and bases the need on the experiences of Barcelona.

It is difficult to arrive at the number of people in Barcelona for whom deep bomb-proof shelters have been provided. But on p. 40 Prof. Haldane mentions one-sixth of the population, and on p. 164 quotes Mr. Skinner that in May "there was shelter for about 240,000 people in brick-lined tunnels"; Prof. Haldane goes on to say, "I do not of course include trenches, cellars, underground railways or any of the types of shelters which are considered good enough for Londoners by our government". On the other hand, Mr. Langdon-Davies, writing in *The Times* in January 1939, states that Señor Tor, who was responsible for the A.R.P. in Barcelona, gave 30,000 as the maximum number of people who had protection against any type of existing bomb.

Complete protection, not only for people, but also for all vital plant, against bombs may be the ideal solution, but the money and time required are prohibitive. Splinter-proof protection gives a very large measure of security, and deep tunnels and concrete bomb-proof shelters are probably only practicable for certain essential workers and vital plant.

(2) Mr. Langdon-Davies in his book "Air Raid" gives a very vivid picture with excellent photographs of the damage that has been done by high explosive bombs in Barcelona, and emphasizes the moral effect of terror and the material effect of blast. The terror was largely produced by the lack of warning and the terrific noise of the explosions. By applying the "Technique of Silent Approach", that is, the shallow dive from a great height with engines off, bombs were dropped on the city before the aircraft were detected and warning given. From this he deduces that similar attacks could be made on London.

It all sounds very creepy. The stealthy silent approach. The blow before you are aware of it. The gliding away in the darkness. But the shallow dive is a well-known method of attack. For places on or near the coast, like Barcelona or Hull, in the face of purely aural detection and in the absence of alert fighting aircraft, the manœuvre is a definite menace. But there are three factors which must be taken into consideration when assessing its danger. The comparatively steep gliding angle of modern fast bombers with their small wing surface necessitates great initial height. To attain this, bombs or fuel must be sacrificed. Bombers must forgo their fighter escorts, and with their engines shut off they are easy prey for the defending fighters. London, with a balloon barrage to keep hostile aircraft up, is more likely to be troubled by an excess of warnings than by a lack of them. The 'silent approach' attacks on Barcelona soon ceased, and it is difficult to believe that the Nationalists would have given up this method if it was so successful, merely because the German and Italian airmen wanted to keep the manœuvre secret for future and more important objectives.

On the effect of blast, Mr. Langdon-Davies is most interesting. Both the pressure and the suction waves caused great damage to windows, doors and the less substantial walls at a considerable distance. Historic monuments were being cased in outer walls which will not only protect them from splinters, but also in the event of a bomb falling nearby, the force of suction will be expended on the protecting wall.

(3 and 4) For detailed advice and practical measures of protection the two professional reports are very valuable. The Institution of Structural Engineers has published the first two parts of its A.R.P. Committee's report. These deal with the published information and the Committee's recommendations for protecting existing buildings. The remaining two parts, on air raid shelters and new buildings, are to follow. The A.A.S. and T.A. report gives diagrams, tables of resistance and cost of both splinter and bomb-proof shelters. In suitable soil, tunnels appear to be the cheapest form that is bomb-proof. The need for accessibility is, however, stressed, and where this is essential, as in a factory of national importance, or where the cost is prohibitive, splinter-proof shelters give a very large measure of protection. With regard to basements, both reports tend to favour the Swiss standard for strengthening the floor directly above the basement against the collapse of the building. This is more than double the strength suggested in the British and German regulations, but no detailed calculations are given. E. H. K.

Standardization of Colours

Horticultural Colour Chart

Issued by the British Colour Council in collaboration with the Royal Horticultural Society. Pp. vii + 100 plates. (London: Royal Horticultural Society, 1938.) 10*s.* to Fellows, 21*s.* to non-Fellows.

COLOUR perception plays a very large part in everyday human experience. Yet most of us are singularly unable to describe colours with exactness, or order them systematically. We find ourselves lacking a yardstick and an exact terminology.

It is possible to analyse and define quite accurately the colour of any object under a given illumination, in terms of relative intensities and wave-lengths of light. But this is a cumbrous business, requiring special apparatus and technical skill. For ordinary purposes, it is easier to fall back on the method of comparison, and a number of attempts to provide an orderly basis for colour comparisons have from time to time been made, by printing standard colour charts. The most notable and widely used of these have been the "Colour Standards" of Ridgeway and of Ostwald, the "Répertoire de Couleurs" of Dauthenay and collaborators, and the later "Dictionary of Colour Standards" of the British Colour Council.

Recently another colour chart, prepared under the general direction of the art director of the Colour Council, Mr. Robert F. Wilson, has been published. The new work is in general layout very similar to the "Répertoire de Couleurs", consisting of loose sheets of handy size (9½ in. × 6¼ in.), in a stiff case. Each sheet, of smooth and white-surfaced paper, gives the name of a colour in English, and its synonyms in Dutch, French, German, Italian, Latin, and Spanish; references to any equivalents in the four older standard charts mentioned above, and a short historical note on the colour or its name; and the colour itself, in four rectangular blocks of increasing depth of tone, down the right-hand side of the sheet, in some instances accompanied by the names of one or more flowers of corresponding colour.

The volume now under notice—a second is projected—deals only with spectrum colours, and omits all the hues, such as browns and greys, which the artist would recognize as admixtures of all three primary pigments. The first sixty-four sheets range in sequence from yellows through oranges and reds to purples, and on through blues and greens back to yellow again. These are very well done, and justify the claim that recent advances in the art of colour printing have permitted increased accuracy of reproduction. To most eyes sheets 15 and 16, Fire Red and Poppy Red, and perhaps also 47 and 48, Oriental and Enamel Blues, show colours approaching one another almost to redundancy. The gardener will note that few examples of flowers in the pure blues can be given.

The remaining thirty-six sheets in the volume are related to certain of the first sixty-four, being either lighter or darker tones of selected hues, and they are numbered in a manner which expresses this relationship. These supplementary sheets are less happily inspired. The user will resent the imposition of fresh names for different depths or 'tones' of the same colour, for example, Carrot Red for paler Orange. This is in direct contradiction of the premise in the introductory notes to the chart, that "There will thus be but one colour name recognised for each hue". The extra name is the more unfortunate because there is actually a very considerable overlap of the colours on the two sheets, so that a given colour may be equally well matched, as, say, Orange, intermediate between the blocks 12/3 and 12/2 in tone, or Carrot Red, intermediate between 612/2 and 612/1 in tone. All the supplementary sheets show this unnecessary duplication of tones on the parent sheet, often only the first or last block extending beyond the range already shown. The amount of overlap is not even constant, being less, for example, between sheets 14 and 614, Nasturtium Red and Chinese Coral, than between sheets 9 and 609, Tangerine Orange and Apricot. In fact, these supplementary sheets might very well have been omitted. The chart would certainly have been simpler and more convenient in use if the increased range of tone had been obtained by adding a fifth block of colour to the sixty-four primary sheets.

Trying out the chart leads to some interesting discoveries. It is perhaps not very surprising that a certain amount of colour-blindness should occur amongst one's friends, hitherto unsuspected by the afflicted themselves; or that there should be great variation in an individual's capacities for memorizing colour. But few people will believe that lemon yellow is a deeper tone of straw yellow, and at first sight the heading "Lemon Yellow" to sheet 4 appears a misnomer. Actually the sheet will be found to include an excellent match for lemon rind; the slightly greenish yellow hue which the name conjures up for most of us is a reflection of the unripe condition in which we get so much of our fruit.

There are few flowers in bloom and most of those given on the sheets as "horticultural examples" are at the time of writing unobtainable. Where it has been possible to check the colours of the flowers quoted, using the methods and precautions suggested in the notes supplied with the chart, confirmation of the careful work of the compilers has been obtained. The common Yellow Jasmine (or at any rate the particular plants at hand) provides the exception, for its corollas certainly match Canary Yellow, 2/1, excellently, and Aureolin, 3/1, where *Jasminum nudiflorum* is given, less well.

The sponsors naturally intend this publication to be primarily a stimulus to the more exact description and recording of flower colours. It is too early to estimate how far this aim will be realized. The price of ten shillings is not prohibitive of fairly extensive use, which is as well, for it is plainly unreasonable to expect nurserymen to spend a good deal of time and trouble matching their wares to the chart, and describing them by reference to it, unless a large proportion of their customers can be expected to possess it. (Some years ago a Continental house actually issued its own chart with its catalogue.) Only the cynical are likely to repine if, before this further onslaught of standardization, romantic fancy is driven from its stronghold in the seed, bulb, and plant catalogues. Where the columns of the gardening press are concerned, the matter is more debatable, for the precise quotation of "Saturn Red (H.C.C. 13/1)" instead of "resplendent flaming orange" would inevitably mean a sacrifice of readability.

The chart will, however, be of utility in a much wider field than horticulture. Many chemists and biologists, especially ecologists, will find it of great value. To the dye, paint, and pigment trades and the textile industries it should be very welcome, although the latter, in particular, will still find the varying texture of surfaces a considerable handicap when colours are being matched.

SAMPSON CLAY.

Debatable Points of Animal Ecology

Problems of Animal Ecology
By Prof. F. S. Bodenheimer. Pp. vii+184. (London: Oxford University Press, 1938). 12*s*. 6*d*. net.

THE science of animal ecology is young, but is rapidly developing, and it is not surprising that its high rate of growth often leads to the formulation of theories, which, on mature consideration, appear to have their foundation not so much on facts, as in the wish to discover harmony and logic in all phenomena of life. It is refreshing, therefore, to see a book such as the present collection of six essays by Prof. Bodenheimer, who sets out to discuss without prejudice several of the outstanding problems of animal ecology.

The first two essays deal with the physiological (or theoretical) longevity and life-history, as compared with the ecological (or actual) processes of life in Nature. Important and new suggestions are made with regard to the methods of studying life-histories against climatic background, but apart from that these two chapters contain little that is of wide general interest.

The third essay, entitled "What really occurs in the *Drosophila* bottle?" deals with modern population studies based on breeding *Drosophila* in a limited space. A long series of original experiments is described, in which the population counts were based on the numbers of eggs, larvæ, pupæ and adults. The results show most convincingly that previous conclusions as to the critical density of populations were at least partly fallacious because they were based on counts of adults alone, and that the final contraction of a population which has been ascribed to "self-regulation", is actually due to intoxication of younger stages in the breeding medium. This is a striking example of a very attractive theory destroyed by mere facts.

The chapter on biological equilibrium in Nature presents a well-balanced estimation of the relative value of climatic and biotic factors in the control of animal populations in Nature. The author (who used to be an enthusiastic adherent of the climatic school) is coming to the conclusion that both the climatic and the biological school are right to some extent and in some cases, and that the truth can be reached only by their combined efforts. He has some good words to say for the mathematical method as applied to these studies, but stresses the fact that most of the conclusions reached by it are based on extremely simplified assumptions and cannot be as yet applied to natural phenomena.

The fifth essay deals with the problem of animal community, the very name of which presupposes some definite organization. The author marshals some good evidence to show that there is no

justification for approaching the study of animal communities in the same way in which plant communities are studied. He defines an animal community as only "a combination of (plants and) animals, recurring in an approximately similar composition . . . wherever similar ecological conditions exist within the same zoogeographical territory". Each species "exists within the community on its own right", and animal community is only "a useful empirical and statistical conception". These conclusions are bound to call forth severe criticisms and stormy controversy, since community studies have lately become very popular and have led to an extraordinary multiplication of terms and conceptions which tend to present animal community as an organized unit, even as a super-organism. In this chapter the author incidentally comes into conflict with himself, since in discussing the factors regulating the distribution of a species he stresses the fact that the physiological characteristics of a species are not constant and may vary both in time and in space. In the light of this undoubtedly true statement, his own method of constructing life-cycle tables for any climate on the basis of a few observations (on temperature alone) in a single climate, as presented in the second chapter, appears to be an unjustifiable procedure.

The last essay is a bold attempt to face and to bridge the gap between the genetical and the ecological approach to the problems of adaptation and evolution. The author points out that ecology is a much younger science than genetics, and its field of action is immensely wide and more varied, so that exact experimentation is practically impossible. "Who will reproach the geneticist for preferring his pure, clear-cut kind of thinking to this chaotic state", says the author, who, however, adds that the superior attitude of the geneticist towards ecology may also be partly ascribed to fear that sooner or later the ecological point of view will have to be admitted into his own field. "When this invasion becomes more and more urgent, he knows that the period of the Olympian mind is over and fears that the consequent revolution of genetics will rob him of the certainty of conceptions and results which are so satisfactory to him to-day." Since "the undisturbed peace of mind of the geneticist is not a final aim of biological research", the author urges geneticists to reconsider their outlook and methods in the light of modern ecological research, which, in its turn, cannot develop successfully without the co-operation of geneticists. This plea for co-operation is long overdue, and one hopes that it will, at least, lead to a discussion which is needed to clear the air.

Taken as a whole, the book deserves to be read by every biologist, and it is regrettable that its style is anything but an easy one, while the editors should have been much more drastic in the matter of the English, which is generally very peculiar and at times difficult to comprehend. The system of numbering separately the references to each chapter makes their use very inconvenient.

B. P. Uvarov.

The Flora of South Africa

The Vegetation of South Africa

By Prof. R. S. Adamson. (Monographs of British Empire Vegetation.) Pp. xvi + 235 + 9 plates. (London: British Empire Vegetation Committee, 1938.) 10*s*.

In compiling this account of the vegetation of South Africa, Prof. Adamson has had the advantage of a very considerable amount of pioneer work, beginning with the celebrated account by Drège ("Zwei pflanzen geographische Documente": 1843), by Bolus ("Sketch of the Floral Regions of South Africa": 1905), and more recently several papers by Pole-Evans and others.

Three chapters are taken up with accounts of physiography, climate and weather, and geology and soils, and the actual account of the vegetation does not therefore begin until p. 86.

For the well-known 'Cape bush', 'fynbos', 'south-western vegetation' (Bolus) or 'macchia,' the term 'sclerophyll' is used. It is composed of shrubs with evergreen leaves of small size and hard in texture, which enjoy a winter rainfall of not less than 12 inches. This vegetation, among which the families Proteaceæ, Bruniaceæ, Restionaceæ, and others peculiar to South Africa are very conspicuous, is further subdivided into five parts, and it contains very few plants of use to man. In the drier eastern portions of the area, *Aloe ferox* is very abundant, and the 'rhenosterbush', *Elytropappus rhinocerotis* Less., represents the most arid kind of sclerophyll.

The forest vegetation, which occupies only 0·3 per cent of the area of the Union, is subdivided into four: (1) temperate forest; (2) warm temperate forest; (3) subtropical forest; and (4) montane forest. Only two of these are of much economic importance. The highest trees of the

temperate forest are *Podocarpus* (up to 150 ft.), whilst another well-known tree of economic value is the 'stinkwood', *Ocotea bullata* (Lauraceæ). Cleared forest land in this area is used for plantations of exotic pines, gums, and other trees, and some of these grow so rapidly that their timber is of poor quality.

The subtropical forest is, perhaps, the most picturesque. In this there are palms, *Phoenix reclinata* and *Hyphaene crinita*, besides the striking *Strelitzia augusta*, whilst the trees are festooned by lianes and a few epiphytes. Mangroves occur in the estuaries and lagoons of Natal, but they are not extensive. The soils of this forest are deep and very fertile, and the crops grown are maize, Kaffir corn, sugar, tea and cotton, whilst bananas, pawpaws, mangoes, pineapples and avocado pears are much in evidence.

Certain floral regions of other authors are classed together under the heading 'savanna vegetation'. This includes temperate savanna, embracing the 'acacia grassland' of Natal, the 'bush veld' which occurs in the northern half of the Transvaal, and the 'low veld' of the north-eastern Transvaal.

Chapters devoted to 'grassland' (high veld) and semi-desert (karoo) follow, and the book ends with a short account of land utilization and natural products, and a most interesting chapter entitled "General Conclusions and Prospects".

Having travelled through all these South African regions, the reviewer desires to offer no criticism of this well-written book other than that the first three chapters might have been much condensed, with fewer meteorological details. The space gained could then have been used for more photographs, of which there are only seventeen, and more detailed descriptions of the regions and the numerous interesting plants inhabiting them, few of which are mentioned. J. H.

Diseases of Trees and Decay of Timber

Forest Pathology

By Prof. John Shaw Boyce. (American Forestry Series.) Pp. x+600. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 30*s*.

PROF. Boyce's work is a welcome addition to the scanty collection of text-books in English dealing with forest pathology. It is mainly concerned to give an account of the diseases of forest trees in North America which are due to plant parasites, and of the fungi which cause decay and stain of timber. Non-infectious diseases are dealt with in a short and summary manner. The book is written to serve a dual purpose. First, it is designed as a text-book and work of reference for foresters in North America, and secondly as a reference book for specialists. The first is, doubtless, its main purpose. This is reflected in the arrangement of diseases according to the organ of the host affected, instead of according to the classification of the parasites concerned, and in the suppression, so far as possible, of technical, mycological and especially taxonomic descriptions. The second purpose is reflected in the carefully selected lists of literature references appended to each chapter.

The quality of the book is seen in the well-informed and carefully balanced discussions, in the well-produced and adequate illustrations, and in the carefully related references to literature. The discussions always seem sufficient to the importance of the subject, especially when one allows for the limitations imposed by the work being confined to a single volume of convenient size, and for the fact that they are written for a North American public. The European reader will find that many pathogens occur which are unknown in Europe, that diseases which are of considerable importance to him are but shortly mentioned, and that no mention is made of many purely European parasites. In spite of this, the book is of considerable value to British foresters; indeed, there is no other written in English which, for them, so adequately deals with forest pathology.

Any weakness in this work, as a text-book, is involved in its limited objective, which is mainly to give an account of the development and means of control of individual diseases, decays, and stains, in relation to the organisms which cause them. Such a treatment is most successful in dealing with phenomena in which these organisms are all-important, such as the decay of converted timber, or the diseases which arise owing to obligate parasites, such as the rusts. It is very much less satisfactory in dealing with diseases which begin their development owing to the action of some non-infectious factor. Such factors receive very much less attention than they deserve, for to the practising forester they are often of great importance. The failure to deal adequately with non-infectious factors has also resulted in there being no sufficient discussion of the etiology of disease within the forest community in general. The discussion on the deterioration of forest products, because of its almost purely biotic

origin and relatively simple etiology, is not affected by the method of treatment.

There is every evidence in this book of great care in preparation. This is seen in the accurate use of terms, in the clear and simple style of writing, and in the freedom from mistakes. The matter is presented in a manner relevant to the needs of foresters, who as a rule are laymen in pathology. If this not infrequently results in a collection of interesting information about a fungus which it would be difficult to identify from the text, recourse can always be had to papers cited. In this way is solved the difficulty of catering both for the forestry student, who must needs learn some pathology for his examination, and for the serious student of the subject, who requires more detailed information. Prof. Boyce is to be congratulated on the successful completion of a difficult task, and English-speaking foresters on the receipt of a book of real value and service.

W. R. DAY.

Chemical Analysis

(1) Gas Analysis

By A. McCulloch. Pp. 166. (London: H. F. and G. Witherby, Ltd., 1938.) 7*s*. 6*d*. net.

(2) Micromethods of Quantitative Organic Elementary Analysis

By Prof. Joseph B. Niederl and Victor Niederl. Pp. xvi+271. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 15*s*. net.

(3) Tables of Reagents for Inorganic Analysis: First Report of the International Committee on New Analytical Reactions and Reagents of the Union internationale de Chimie. By C. J. van Nieuwenburg, W. Böttger, F. Feigl, A. S. Komarovsky, N. Strafford. Pp. xxiv+409. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 36 gold marks.

IN these days of extreme specialization, it can scarcely be expected that the basic subject of analytical methods will escape selective treatment. The trend is manifest in the preparation and publication of small text-books in which the methods applicable to the practice of a particular industry are selected: these probably save a good deal of time to workers in the special subjects, and to students taking limited laboratory courses in which the practice, rather than the art, of chemistry is demonstrated.

(1) A good example of such books is that on gas analysis, a subject which is much to the fore both in connexion with fuel technology, the science which is enabling one ton of coal to be burnt where three tons were necessary before its application, and in relation to syntheses from elementary gases in presence of catalysts. It covers the field satisfactorily without going into great detail; the more complex apparatus for analysing mixtures of hydrocarbons is omitted.

(2) Quite another field is the micro-analysis of organic substances which has rendered it possible for the research worker, particularly in the biochemical field, to make astounding progress with quite small quantities of material. Pregl, in Vienna, made the start in this work; his methods have since been copied, adapted, and improved in many centres. The latest book comes from the New York University in Washington Square, and describes and figures the apparatus required, and how to use it. In large research laboratories it is becoming usual, and, indeed, necessary, to set aside a special room for this purpose staffed by competent assistants, who give their whole time to the work. It is good news to hear that there is about to be such a laboratory at the Imperial College, South Kensington.

(3) A third line of development worthy of emphasis is that of reagents. During the last decade the technique of qualitative analysis has been facilitated by the use of an exceptionally large number of new reagents, many of them organic compounds. The Union Internationale de Chimie has set up a Committee of five to report on new analytical reagents and reactions, on which Mr. N. Strafford, of Manchester, represents Great Britain; the report takes the form of a book largely in tabular form, in three languages, an achievement which is in itself substantial.

There are so many new reagents that teachers are faced with problems regarding their suitability which they lack the time to investigate. The report aims at giving help to this end, and contains full information, with references to all the reagents discovered in the period 1910–36. Some of them bear the indication "recomm."

Such a book was badly needed, and will no doubt find shelf room in every laboratory. It is printed and published in Germany.

It is pleasing to have this result of international co-operation, and it may be hoped that, in future, these congresses will more and more have the effect of getting the chemists of the nations to work together to similar ends.

The Silica Minerals

Quartz Family Minerals
A Handbook for the Mineral Collector. By H. C. Dake, Frank L. Fleener and Ben Hur Wilson. Pp. xvi+304. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 12*s.* 6*d.*

IN an age when thousands of books are published annually, covering almost every subject, it seems remarkable that so few have been written to introduce the general reader to the wonder and beauty of the mineral kingdom. In the United States some attempts have recently been made to fill this gap in the literature—an outstanding example being "Getting Acquainted with Minerals" by G. L. English. The present work is of the same persuasive kind, and though limited in its field to the silica minerals, serves also as an introduction to general mineralogy.

Like so many other of the common minerals, quartz possesses properties of the deepest scientific interest and furnishes problems, many of which still remain unsolved. Moreover, since some 60 per cent of the lithosphere consists of silica, a great part of which is in an uncombined state, ample material for first-hand study can be gathered by the collector in almost any part of the world, or can be purchased cheaply from a mineral dealer. "Quartz Family Minerals" opens with an explanation of the importance of quartz and a brief survey of its use in past ages. After two excellent chapters, in which the authors discuss the various conditions which led to the deposition of silica minerals in the rocks, a description is given of the quartz crystal habit and of the various types of quartz—crystalline, crypto-crystalline and amorphous.

There is a long chapter on agate; theories of the manner of its growth are discussed and prescriptions given for producing banded, agate-like precipitates in suitable gelatin media on the Liesegang ring principle. Chapters on opal and on petrified forests complete the descriptive part of the book.

Naturally enough, in a work intended for American readers, the localities quoted for each variety of mineral are preponderantly American. Thus in the section on sand-filled calcites no mention is made of the curious sand-calcite rhombohedra found at Fontainebleau, so well known to the European mineralogist. The beautiful Mexican 'water opal' is not described, and quartz cat's-eye is dismissed in a single short sentence. The last twenty pages of the book deal with "The Art of Cutting Gem Quartz". In an appendix is given a selected bibliography of books and articles on the silica minerals and precious stones generally, in which the standard British work, G. F. Herbert Smith's "Gemstones" and Liesegang's classic, "Die Achate", should have been included.

Numerous misprints, and one or two factual errors, will need correction in future editions. On p. 36 it is stated that "the purest quartz (rock crystal) has a specific gravity of 2·69" whereas the correct figure is 2·654; and on p. 176 fused quartz imitations of amethyst, etc. are said to have the "identical hardness and specific gravity" of the natural gem, which is by no means true.

Much interesting material, gathered from widely scattered sources, is collected together in the book, and it is well illustrated; it can be read with profit not only by the beginner but also by the more advanced mineralogist. B. W. A.

Applications of Ultrasonics

Ultrasonics and their Scientific and Technical Applications.
By Prof. Dr. Ludwig Bergmann. Translated by Dr. H. Stafford Hatfield. Pp. ix+264. (London: G. Bell and Sons, Ltd., 1938.) 16*s.* net.

THE scientific study of ultrasonics, or the properties of high-frequency inaudible mechanical vibrations, may be said to date from the year 1883, when Galton published his book "Enquiries into Human Faculty". In this book he described the construction of the Galton whistle, an instrument which, refined in some details, is used to this day by psychologists and physiologists for the production of sounds of high pitch. The subject remained of little more than academic interest until, during the Great War, Langevin devised the first practical apparatus for the transmission and reception under water of inaudible 'sound' signals. For this purpose, Langevin utilized (1) the discovery by the brothers J. and P. Curie of the piezo-electric properties of quartz, and (2) the methods of generating and detecting electric oscillations made possible by the invention of

the three-electrode thermionic valve. Langevin saw quite clearly that the use of disturbances of short wave-length enabled him to exploit the effects of unidirectional propagation, reflection, refraction, interference, diffraction, etc., until then more usually associated with optical phenomena. He might justly be called the 'Father' of modern ultrasonics.

Soon after the end of the War, Cady showed that the piezo-electric property of quartz could be used to maintain and control the electric oscillations in a suitably designed valve-amplifier circuit. A little later, Pierce and the late J. H. Vincent independently developed similar oscillators based upon the magnetostrictive properties of iron and nickel and their alloys. Almost all the latest developments of ultrasonics have been concerned with the applications of these two methods of producing high-frequency vibrations to various problems of science and industry. Mention may be made of submarine signalling, echo sounding, the sterilization of milk, the preparation of photographic emulsions, television scanning and precision time-keepers. A considerable impetus was given to such investigations by the publications in 1927 of R. W. Wood and Loomis on the physical and biological effects of high-frequency sound waves of great intensity. These investigators showed how large amounts of energy could in this form be communicated to small portions of matter, with the result that surprising mechanical, thermal, chemical and biological effects were observed.

Until the publication of this book, no comparable comprehensive account existed in the English language of the achievements of ultrasonics and the present state of development of the subject.

Dr. Bergmann's book supplies the need of the moment in a most happy manner, and we have nothing but praise for it.

Particularly valuable is the discussion of the optical methods of measurement and investigation given in chapters ii and iv. The English edition of 1938 differs from the original German one of 1937 by the inclusion of an account of the application of ultrasonics to television, and a list of references to papers published in the interval.

The book is well printed and well illustrated, and shows little evidence that it is a translation and not an original version. We heartily commend it to all who are interested in any branch of this fascinating subject.

F. L. HOPWOOD.

Radioactivity, New and Old

A Manual of Radioactivity

By George Hevesy and F. A. Paneth. Second edition, completely revised and enlarged. Translated by Robert W. Lawson. Pp. xvi+306+5 plates. (London: Oxford University Press, 1938.) 17*s*. 6*d*. net.

THIS book was published originally in German in 1923, then in English in 1926 (reviewed in NATURE, **118**, 475; 1926), again in German in 1931 (reviewed in NATURE, **129**, 560; 1932), and now appears a second time in English. This new edition has come out at a most appropriate time. It is the only book of its size and scope that includes the great discoveries that have been made in the subject since 1932, discoveries which in fact and interest have exceeded the wildest dreams of the most sanguine workers of ten years ago. They have so enriched and enlarged the subject of radioactivity that the earlier treatises published before 1932, excellent as they were when they appeared, are, if still readable, greatly shorn of interest.

The discovery seven years ago that nuclei of light atoms could be changed by artificially accelerated protons shattered the old view that that kind of thing could be done only by the spontaneously ejected α-particles from rare and costly elements. Then came heavy hydrogen and the neutron. These had scarcely been discovered before it was found they were excellent projectiles against nuclear targets, and the neutron, in particular, whether slow or fast, has proved so effective against almost every atomic nucleus bombarded that the profusion and variety of the results have become an embarrassment to the compiler.

All this was, in a sense, an extension of Rutherford's original work on artificial disintegration by bombardment, but in 1933 something quite novel forced itself on the attention of experimenters: the production from atoms, radioactive or not, of unstable nuclei which themselves were radioactive, emitting either the β-particle of natural radioactivity or a new particle, the positive electron, which a year earlier had been found in the cosmic radiation. One result of this advance was the extension of the list of elements at the heavy end; radioactive isotopes of the new elements 93, 94, 95, 96 have been prepared by bombardment of uranium and have given the chemist some idea of the chemical character of eka-rhenium, eka-osmium, eka-iridium, and so on.

In this new edition, concise accounts of this recent work have been embodied in the fuller descriptions of the older and fundamental experiments and theories. The book is not overloaded with the new material. It still retains its characteristics as a text-book for the ordinary student of physics and chemistry. The new chemistry (the production of one kind of element by bombardment from another) and the new artificial radioactivity are admirably related to the old pre-1932 radioactivity which derived from the disintegration theory of 1902–3. Here in three hundred pages, as nowhere else in English, the student is given an account of a great subject in all its important physical, chemical, geological and biological aspects. It is a pleasure to welcome this new edition. A. S. R.

Vectors

An Introduction to Vector Analysis

For Physicists and Engineers. By Dr. B. Hague. (Methuen's Monographs on Physical Subjects.) Pp. viii+118. (London: Methuen and Co., Ltd., 1939.) 3*s*. net.

"VECTOR analysis is the natural means of expression for the three-dimensional problems of physics and engineering, because its conciseness and freedom from mathematical detail enable the relationships between the various physical quantities to be kept clearly in view". This is the first sentence in the preface of the book under review. The author continues: ". . . it has now become almost essential for any advanced worker in these sciences to have some knowledge of vector analysis. Much good work can be done with the aid of a very few elementary principles. It is the object of this monograph to give an introduction to these principles and to explain them from a physical standpoint, so that they may be easily available to the busy physicist or engineer approaching the subject for the first time. Such workers are usually so much occupied by their major task as to lack the time necessary to enable them to seek out such principles as they need to use from the more comprehensive treatises which aim at mathematical completeness. This monograph is not, therefore, intended for the readers with purely mathematical interests, whose more rigorous and systematic requirements are fully satisfied elsewhere. For these reasons the outlook adopted is almost entirely physical; geometrical matters and questions of an exclusively mathematical interest are limited to essentials. Formal proofs of invariance and conditions of continuity in vector processes are replaced by an appeal to physical intuition. Purely analytical topics of an advanced kind, such as Green's theorem, are justifiably omitted from such an introductory treatment as this monograph aims to present. . . ."

The author later directs the attention of the reader to "the inclusion of a chapter giving a brief sketch of the elementary properties of tensors and dyadics in their relation to vectors. This is a subject which usually puzzles and often repels physics and engineering students because of the abstract mathematical way in which it is usually brought to their notice".

Finally the author informs his readers that "The monograph is based on a course of lectures given a few years ago to post-graduate electrical engineering students in the Polytechnic Institute of Brooklyn, New York".

I have quoted at this length from the preface because I feel strongly that the author has done a valuable service to students and teachers of applied mathematics in producing this small but comprehensive account of vector (and even the elements of tensor) analysis. The publishers also deserve praise for making available at so modest a price a book of 118 pages, including much mathematical printing and 39 diagrams (mostly excellent). In thus commending the book and those to whom we owe its production, I am not endorsing all its contents; there are many things in it that I think might better be put differently (and at no greater length), and a few that seem misleading; but all these points can be dealt with by teachers who may commend the book to their students, as I shall to mine; and readers who study the book by themselves can gain so much knowledge thereby, well set forth in small compass, as will far outweigh the few deficiencies of the treatment.

It is a remarkable sign of the ever-widening vogue of vector methods that this book has been written by an engineer. It is also remarkable that these methods have taken so long in winning adoption, still far from universal. The author points out that even Maxwell, who introduced the fundamental vector ideas into the theory of the electric and magnetic fields, did not make any use of vector analysis in manipulating his equations, relying entirely upon the usual lengthy Cartesian methods. The pioneers of vector methods in applied mathematics were Gibbs, Heaviside and

Lorentz. I recall that my own teacher, Horace Lamb, whose lectures and books were first-rate, never appreciated vector methods; he regarded vectors merely as a means of concise expression (in his view a rather dangerous conciseness), and had no conception of their value in mathematical manipulation.

Dr. Hague's book is already so full of excellent matter that examples on which the reader may practice his 'prentice hand in vector manipulation are not included and could not be expected, nor is guidance given as to how such skill can be acquired and used, beyond references to further reading on vectors. His inclusion of a brief chapter on tensors and dyads will, it is to be hoped, interest many readers in this fascinating branch of mathematics.

S. CHAPMAN.

Courses in Engineering Science

(1) Mechanical Engineering Science

A Second Year Course. By Dr. Arthur Morley and Dr. Edward Hughes. Pp. xiv+260. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 4*s*. 6*d*.

(2) Engineering Science

By H. B. Brown and A. J. Bryant. Vol. 2: Heat and Heat Engines and Electrotechnics. Pp. x+450. (London: Macmillan and Co., Ltd., 1938.) 6*s*.

(3) Engineering Mechanics

By Prof. Seibert Fairman and Prof. Chester S. Cutshall. Pp. xi+267. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 13*s*. 6*d*. net.

IT is of interest to observe the variety of views which are current as to the way in which the science of engineering is to be taught, more especially as they are indicated in the text-books of the day. While engineering is, in one sense, merely a branch of applied physics, the training of the engineer must necessarily be conducted on lines fundamentally different from those on which the physicist is prepared for his life's work. Prof. Southwell has pointed out that the problems of the engineer are inexorable and are recognized by him as so. The physicist, barred from progress in one attempted path, is free to try another; the engineer must solve his problem as it is presented, and some solution he must have even though it may only be approximate. From this it clearly follows that the engineer must study his subjects from the practical point of view, and that he inclines not to draw fine distinctions between them but rather to regard them as parts of one whole. Such distinctions as are made are more for convenience than otherwise, and to him the main end is to be able to estimate the practical effect of all the influences which bear upon any work in hand.

Up to about twenty-five years ago, the general practice in technical institutes in Great Britain was to provide a course consisting of quite a number of subjects, each dealt with in a separate class, with clear-cut distinctions between them. Since then, a tendency has been noticeable towards grouping these individual subjects in more general courses under some such comprehensive title as 'engineering science'. This, no doubt, makes a more attractive-looking subject to the less keen type of student, and it also recognizes in some measure the essentials in an engineering training.

(1) An example of this is the course suggested for National Certificate students by Dr. A. Morley and Dr. E. Hughes. In their text-book "Elementary Engineering Science", the work of the first year in statics, heat and electrical technology was set out. They have now followed this with a second-year course for students of mechanical and of electrical engineering in a more recent text-book, "Mechanical Engineering Science", in which are presented dynamics, energy, hydraulics, and the mechanics of gases, leading up to the principle of the heat engine and a descriptive and explanatory section on engines and boilers.

As in the earlier course, emphasis has been laid on energy as the principal method of approach to the problems which these sections present, and the subject is demonstrated largely by means of practical examples fully worked out. It is in this respect that the book attains its highest qualities, for these examples have been well chosen and are methodically elaborated, no essential step being omitted. The explanatory text might, however, have been arranged in much more simple and direct terms and so have had more appeal to the ordinary student. For example, a straightforward statement of the engineer's point of view as to inertia, mass and weight would have been better than the postulation of different aspects which are not fully discussed and indeed cannot be. Thus they leave the student in some measure of doubt and hesitancy.

(2) A somewhat different sequence has been adopted in "Engineering Science", by Brown and Bryant, the first volume of which presented a first-year course in applied mechanics and hydraulics.

The second volume now shows the work of the second year to be devoted to heat, heat engines and electrotechnics. The scope is thus kept within somewhat narrower bounds, but the treatment goes deeper and, being direct and practical, should make an appeal to both students and their teachers.

The main principles have been stated clearly and succinctly, and the approach to the subject is largely by experiment and deduction. The course outlined is a progressive one and provides a good preparation and basis for the more specialized studies which have to follow, and the student will get considerable help from the numerous illustrations of machinery and apparatus which have been supplied by their makers.

(3) In the preparation of "Engineering Mechanics" by Fairman and Cutshall, the authors have adopted quite a different method of overcoming the difficulty of keeping within the available facilities for study. Appreciating that in institutions where time is limited by the requirements of other subjects in the curriculum a full basic course cannot be attempted, they have eliminated those portions which must, in any event, be dealt with in more specialized classes and may therefore be deferred until later. They hold that a task is more easily accomplished if all the tools are available, and therefore, at each stage, make careful preparation for it by setting out and explaining clearly the methods, conditions, and the fundamental laws of physics applicable.

The course is one of general mechanics as applied to engineering, and includes statics, dynamics, friction, energy, balancing, impulse, impact and gyroscopic action. It is intended for students who have had a training in mathematics up to the integral calculus, and for such as have this preparation it offers a clearly stated exposition of the subject with a discreet mixture of problems of the practical and the academic types.

Modes of Thought

Modes of Thought

By Prof. Alfred North Whitehead. Pp. x + 241. (Cambridge: At the University Press, 1938.) 7*s*. 6*d*. net.

PROF. A. N. WHITEHEAD'S latest book consists of eight lectures and a short address as epilogue. Two of the lectures have been published before under the title "Nature and Life". Any reader who is unfamiliar with the author's philosophy would be well advised to begin with the first of these (Lecture VII). Prof. Whitehead points out there that according to the traditional doctrine of science, which has been taken over by common sense, Nature consists of permanent things, bits of matter, moving about in a space which is otherwise empty. The connexions between such bits of matter are purely spatial, and therefore motion is the only mode of change. Modern physical theory contradicts everything this doctrine asserts, nevertheless it remains as a general presupposition.

The result is a complete muddle in thought, yet any theory which does not presuppose the traditional view seems paradoxical. The traditional view, it is argued, is not merely inconvenient, but definitely self-contradictory. The only final real fact admitted by it is "this bit of matter occupying this region of space at this durationless instant", without reference to any other instant or any other piece of matter or to any other part of space. But what are we to make of velocity, acceleration or momentum at an instant? These notions are necessary for physics, and yet are without meaning on the traditional view. For the modern view, process, activity and change must be taken as primary matter of fact. At an instant there is nothing. Each instant is only a way of grouping matters of fact by taking a cross-section through them. All interrelations of matters of fact must involve transition. Each concrete fact is the consequence of a process of 'concrescence' from other facts. In its turn it gives way to contribute to the concrescence of others. A thing becomes real by being involved in the "creative advance of nature". The notion of creative advance is the starting-point of Prof. Whitehead's theory.

The rest of the book is concerned with the development of certain aspects of this fundamental notion. The treatment is useful and illuminating for anyone who already knows something of his views. To anyone not so prepared a good deal of it may be puzzling. The author's mode of expression, though often most happy and usually clear, is sometimes elusive. Unfortunately the opening pages are of this character, and might frighten off an unwary reader.

It is interesting and cheering to find Prof. Whitehead, who cannot be accused of ignorance of mathematical logic, combating the fashionable doctrine that arithmetical propositions are all tautological. The doctrine has been propagated with the help of such a terrifying array of technicalities that scarcely anyone has dared to protest against it.

A. D. RITCHIE.

SHORT NOTICES

Anthropology and Archæology

The Southern Bantu

By L. Marquard and T. G. Standing. Pp. vii+262. (London, New York and Toronto: Oxford University Press, 1939.) 7*s*. 6*d*. net.

THE aim of the authors, it is stated, is to remove some of the hindrances to understanding which subsist between the white race and the black. Few who have set out with the same unimpeachable purpose have come nearer success than they do in the few pages of introduction, in which they show how differences in manners and etiquette as between the two races, matters of long tradition, lead to mutual misinterpretation, misunderstanding, or disapprobation. For example, the Bantu is stigmatized as 'furtive' because his etiquette eschews the direct glance, which the European, rightly or wrongly, interprets as a mark of honesty; and this is only one of a number of points, ostensibly trivial, but important in this connexion and cumulative in effect, which give rise to lack of ease in intercourse, or even friction.

From this excellent and sympathetic beginning, the authors conduct the reader through a rapid but adequate survey of the history, social organization, material culture and beliefs of the Bantu of the Union of South Africa, Southern Rhodesia, the Protectorates, and the Mandated Territory of South-West Africa. Full emphasis is laid on the fact, often overlooked in discussion and controversy, that these peoples vary widely in characteristics and culture, notwithstanding a general resemblance. Following on this survey, which will give the reader who is not a specialist in the anthropology of southern Africa an adequate idea of the material with which the native problem, so-called, is concerned, the authors pass on to the conditions of the life of the native as he lives it in the reserves, on European farms, or in European towns, and then set out the circumstances of administration of native affairs, economics, industry and occupation, land tenure, religion, education and the like.

Treatment of the material throughout is objective, and the authors, beyond stating opinions which are generally accepted, refrain from drawing conclusions from the facts. This is left to the reader.

The Origins of Early Semitic Ritual

By Prof. S. H. Hooke. (The Schweich Lectures of the British Academy, 1935.) Pp. xi+74+3 plates. (London: Oxford University Press, 1938.) 6*s*. net.

THE more intensively the material brought to light in the archæological excavation of the Syrian site of Ras Shamra, the more clearly is its importance realized in relation to the study of the culture of western Asia in the second millennium B.C. It is the source upon which Prof. Hooke relies mainly for his most illuminating material in his study of the origins of Semitic religion, which formed the subject-matter of his Schweich Lectures before the British Academy in 1935. His purpose was to relate the ritual practices of the Hebrews, as contained in the Old Testament, to the rituals of Mesopotamia and Canaan. This is now possible, but only through the information which has been amassed in the excavations of archæologists in the Near East of recent years. As the author points out, such elements of Hebrew culture as the Passover can now be related to the ritual practices, which existed in their ancient Semitic environment.

The first lecture is devoted to the sources and types of Mesopotamian ritual, material familiar to the archæologists, but as Prof. Hooke suggests, not equally well known to students of the Bible; the second deals in like manner with the ritual of Canaan. It is in connexion with the latter that the material from Ras Shamra is most valuable, for we now have for the first time a contemporary account of Canaanitish practice at a crucial moment, hitherto known only from much later and more biased sources. The third lecture brings the Hebrew ritual into relation with the two systems previously discussed, the process suggesting the possible importance for Hebrew culture of Hittite and Hurian influence.

Witchcraft in the Star Chamber

By C. L'Estrange Ewen. Pp. 68. (London: The Author, 103 Gower Street, W.C.1, 1938.) 3*s*. 6*d*.

MR. EWEN, whose two earlier books on witch trials drew mainly on the records of the assizes, has now extended his researches to cases before the Star Chamber in the early years of the seventeenth century, not long before its abolition in the reign of Charles I. This court was a convenient and inexpensive method, for the less wealthy members of the community, of seeking redress in a civil action. Its records of trials afford an interesting and in certain respects an enlightening view of the reactions of persons accused of witchcraft. For the cases which came before the court were not witch trials—these went to the assizes—but actions for slander or libel brought by the alleged witch, usually after acquittal in another court, claiming damages from the accuser.

The statements of claims give some interesting information as to the character of the alleged bewitching; but while in some instances there is evidence of a genuine belief in the powers of the witch, not infrequently it is clear that behind the accusation lay the real motive—a family feud, a squabble between the wives of tradesmen, jealousy, or a dispute over property. An accusation of witchcraft would secure removal of an enemy or rival by incarceration for a time at least, and even if unsuccessful left a stigma, which carried with it social

ostracism and even danger of assault by the mob. One of the most interesting cases comes from Berkshire—demoniac possession of a girl of fourteen, a clear case of hysteria, which was investigated personally by King James I, who was a great demonologist; while in another from Oxford the motive of accusation was evidently blackmail.

Biology

German-English Botanical Terminology (Englisch-Deutsche Botanische Terminologie)

An Introduction to German and English Terms used in Botany, including Plant Physiology, Ecology, Genetics and Plant Pathology. By Dr. Helen Ashby, Prof. Eric Ashby, Dr. Harald Richter and Dr. Johannes Bärner. Pp. xi + 195. (London: Thomas Murby and Co., 1938.) 10*s*. net.

ON its publication by Messrs. Murby and Co., "German-English Geological Terminology" received such unanimous approval that the publishers have decided to issue "Terminologies" in other sciences along similar lines. The decision is a happy one, for the series is being written on novel lines.

This book deals with botanical terminology, and the editor of the series clearly made a wise choice in his British and German authors. The book will form excellent material for the student of botany who is learning technical German, for, instead of being a mere vocabulary of German-English terms, it is actually a survey of botany given in English on alternate pages with the German equivalent on the opposite pages.

The subject-matter is divided into: two chapters on plant morphology, two on classification and phylogeny, one on cytology and genetics, one on plant physiology, one on ecology and one on plant pathology. In appendixes are given lists of common European plants, common names of plant diseases, abbreviations frequently used in German botanical literature, and abbreviations used in English botanical literature.

The whole method of approach is commendable, since the book will help the student to enlarge his vocabulary and become familiar with botanical terms in German and English almost subconsciously while reading and revising his botany. Above all, the reader will have impressed upon him the very important fact that the same idea is often expressed differently in German and in English.

We would strongly recommend every student of botany reading for a university degree in the subject to obtain a copy of this very useful work.

Ascaris: the Biologist's Story of Life

By Dr. Richard Goldschmidt. Pp. viii + 312. (London: English Universities Press, Ltd., 1938.) 10*s*. 6*d*. net.

DR. R. GOLDSCHMIDT has written this book in order to provide an introduction to biology for readers with no previous knowledge of science. Taking as his unconventional starting-point the parasitic worm *Ascaris*, he uses it as a text for a very readable account of modern conceptions of physiology, experimental morphology, and genetics, with excursions into bionomics and ecology. In all these matters it need scarcely be said that the distinguished author is a trustworthy guide, and from his point of view the survey is doubtless a well-balanced one.

From another angle, however, the perspective would be very different. Dr. Goldschmidt writes as a convinced mutationist. Mutations arise with "no relation to usefulness or non-usefulness"; natural selection is merely the elimination of the grossly unfit; inheritance of impressed modifications does not happen; organisms having acquired new characters can "afford to look for new modes of living" but otherwise adaptation is an unsolved and perhaps insoluble mystery. It is true that he does not, like some modern biologists, expressly disclaim all curiosity as to evolution. The account of the vertebrate ear leads him on a brief excursion into comparative morphology and even phylogeny and 'recapitulation', although palæontology is barely glanced at. Nevertheless, with the reservation that there is a great deal more to be said on all these points, the book is one to be recommended to the university student as well as to the layman or the "not-too-tired" business man mentioned in the preface.

Actual mistakes are few and trivial, but surely "the Kergueles" is scarcely a happy designation for the islands discovered by and named after Yves Joseph de Kerguelen Trémarec. W. T. C.

Chemistry

The Chemical Studies of P. J. Macquer

By Dr. L. J. M. Coleby. (History of Science Library.) Pp. 132. (London: George Allen and Unwin, Ltd., 1938.) 6*s*. net.

ONE of the outstanding French chemists of the eighteenth century was Pierre Joseph Macquer (1718–1784). He was the author of a dictionary of chemistry which went into a second edition and was translated into English as well as other languages, and in addition to valuable investigations in pure chemistry he was director of the dyeing industries and superintendent of the State factory at Sèvres for the manufacture of porcelain. Mr. Coleby has given a clear and interesting account of the work of Macquer which is based on the original sources, and his book is a useful contribution to the history of chemistry.

The Elements of Physical Chemistry

By F. W. Goddard and Dr. E. J. F. James. Pp. viii + 251. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 5*s*.

THIS text-book is planned to meet the requirements of students preparing for Higher Certificate, First Medical, and University Entrance Scholarship examinations. The text is clearly written and on the whole very suitable in standard for the aim of the book. The section on atomic

structure requires correction, since it assumes that the atomic nucleus contains electrons, and it is doubtful whether the circular diagrams of atoms are the most suitable for explanations of valency. It is questionable whether adsorption should be introduced into the section on solutions. The sections on solutions and electrolysis are very good, and give an adequate account of the subjects; that on catalysis is rather old-fashioned, and the reactions given on p. 213 for the lead chamber reactions would be more accurate if water were introduced into the first.

A good feature of the book is the emphasis laid on numerical calculations, and the excellent series of problems given at the ends of the chapters will be very helpful on this side. The book is one which should prove useful both to junior students and to teachers.

Geography and Travel

Physiography of Eastern United States

By Prof. Nevin M. Fenneman. Pp. xiii + 714 + 7 plates. (London and New York: McGraw-Hill Book Co., Inc., 1938.) 36*s*.

THE equivalent in Great Britain of the term physiography is geomorphology, and that is the content of this book. It is planned and written on the same lines as the author's volume on the Western United States which was published seven years ago. The area now covered stretches westward across the Mississippi basin to the edge of the High Plains. It is a massive book, full of detail, arranged under the provinces which in America are the generally accepted physical divisions. As a whole these are the divisions of the country accepted by the United States Geological Survey.

The material available to the author was abundant, though of varying value in different provinces. He has tried, and with a large measure of success, to produce something more than a mere compilation of details. There is certainly much purely descriptive matter, but the broad issues of geomorphological evolution are never lost to view. One might, however, wish for a chapter or two of general summary for those who have not time for the fuller treatment. The book is fully documented on every page and has a number of maps.

Northernmost Labrador Mapped from the Air

By Alexander Forbes, with Contributions by O. M. Miller, N. E. Odell and Ernst C. Abbe. (American Geographical Society Special Publication No. 22.) Pp. xx + 255. Navigational Notes on the Labrador Coast. By Alexander Forbes. Pp. 26 + 6 plates. (New York: American Geographical Society, 1938.) 4 dollars.

THE greater part of this book contains accounts of aerial surveys made in Northern Labrador in the summers of 1931, 1932 and 1935. Previous maps of that part of Labrador were vague and generalized on the whole, although some of the inlets had been charted. Details of the organization, equipment and methods are given with much general information about the country. The methods are fully described by Mr. O. M. Miller. The net result was a map of some 4,000 square miles extending from Nachvak fjord to Cape Chidley, most of which is produced on a scale of 1 : 100,000. The sheets accompany the monograph in a separate cover. In addition to this side of the work the volume contains a number of other useful articles, including one by Mr. N. E. Odell on the geology and physiography, and another by Mr. E. C. Abbe on phytogeographical observations, and a separate pamphlet of Navigational Notes on the Labrador Coast by Mr. A. Forbes. The flora of the higher mountains contains many of the same species as the nunataks of Greenland. These Dr. Abbe regards as the hardiest members of the flora, but he does not believe that they survived through the last glaciation on nunataks, which Mr. Odell in any case does not think existed. He favours the hypothesis of relatively rapid migration northward in a past glacial optimum. Subsequent refrigeration may have resulted in a shrinking of the distributional areas of these species.

The volume contains a large number of fine photographs illustrating every aspect of the work.

The South

Its Economic-Geographic Development. By A. E. Parkins. Pp. ix + 528. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

THE title of this book refers to the sixteen States in the south-east of America from Delaware and Maryland westward to Oklahoma and Texas. This area covers a great deal more than the plains of the south-east and the cotton belt since it embraces much of the Appalachian uplands, but is nevertheless a fairly well-defined region on economic and cultural grounds. Mr. Parkins attempts to give a survey of this area leading from physical factors and historical records to the present geographical and economic conditions. In short, he is concerned with an interpretation of life as it exists to-day, in a region that is primarily agricultural but in which agriculture is changing in aspect and intensity and where mining and manufactures are beginning to play an important part. The book, which is well documented and has abundant maps and illustrations, is a valuable contribution to the geography of the United States, and is, moreover, a good example of geographical reasoning.

R. N. R. B.

Engineering

Carburettors and Fuel Systems

The Theory, Application, Construction, Fitting, Testing, Tuning and Maintenance of Carburettors and other Fuel Combustion Devices. By Arthur W. Judge. (Motor Manuals: a Series for all Motor Owners and Users, Vol. 2.) Third and revised edition. Pp. 362. (London: Chapman and Hall, Ltd., 1938.) 6*s*. net.

THIS, the second volume in a series of four motor manuals which have proved very popular, has now reached the stage of being issued in a third

edition. The series has been designed to present in simple and, so far as possible, non-technical terms the essentials of each branch of the subject, so that it might be of practical service to all who are interested in the motor-car. With this aim in view, its principal features have been descriptions and explanations of the construction and operation of the several parts of the car. Theory has only been introduced to a limited extent, and in the present volume a short introduction puts the reader in possession of the main points as to the theory of carburation, the chemical and thermal properties of fuels, and the process of combustion. Starting from the simplest types of carburettor, the author builds up a picture of the development of this delicate piece of apparatus as further and further improvements were indicated by the need of greater economy and smoother running of the engine. He retains descriptions of older models because they embody important and interesting principles.

Of up-to-date types a large number are illustrated and described, and among the more recent developments dealt with are the various types of British and foreign carburettors having original systems of mixture compensation, automatic air chokes, acceleration pumps, power jets and other special features. The subject is treated very broadly, as, in addition to those for motor-cars and motor-cycles, carburettors for aircraft are also included, so that with the chapters treating of such ancillary matters as air cleaners, fuel feed systems, design of inlet manifolds, vaporization and testing, tuning and trouble tracing, the information given is very complete of its kind. In its extended form it should continue to prove of great help to motorists, repairers and students and to enjoy a full measure of popularity.

Theory of Alternating-Current Machinery

By Alexander S. Langsdorf. (Electrical Engineering Texts.) Pp. xviii+788. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36*s*.

THIS large volume is devoted solely to the theory of the steady state of electromagnetic A.C. machinery (thus excluding electronic devices such as mercury arc rectifiers). Questions of design are touched only so far as they form the background from which the theoretical problems arise. The wide field thus available enables the author to adopt a comprehensive and at the same time broad and easily readable treatment. A specially commendable feature of the book is that the usual analysis by means of vector diagram and complex algebra is always preceded by a very full discussion of the physical relations. In this connexion the chapter on asynchronous machines, which can well be read independently of the rest of the book, should be of special interest to students.

Other noteworthy features of the book are: in the introductory part a special chapter on the theory of polyphase current systems which includes an introduction to the method of symmetrical components, in the treatment of the transformer a discussion of the transformer with three windings, and in the chapter on synchronous machines a simplified presentation of the Doherty-Nickle theory for the calculation of armature reaction in machines with salient poles. The book can be thoroughly recommended.

A. B.

Autographic Indicators for Internal Combustion Engines

By J. Okill. Pp. 88. (London: Edward Arnold and Co., 1938.) 5*s*. net.

THIS is a subject which has been somewhat neglected and, as a result, connected information regarding the use of indicators on internal combustion engines is not readily obtainable. The author, who designed that most useful instrument, the Okill maximum pressure indicator, has given the matter much study and, in this monograph, presents a range of information and suggestions which should be most acceptable to those who have not had an extensive experience in the manipulation of these instruments. His survey is limited to the combined piston, spring and pencil-lever types, and traces their development from the original instrument devised by Watt about 1790 to the very carefully proportioned and accurate types now made to suit the severe requirements imposed on them by high-speed internal combustion engines. The possibility of inaccuracy and distortion of diagrams arising from piston friction, overheating and mishandling are pointed out and the methods of testing and calibrating the pencil movements are described. Then after dealing with inertia effects, spring vibrations and the correct forms of connectors, operating gears and other details, a number of present-day instruments are described and explained. The book should therefore be a most useful guide to the many engineers who depend on the indicator for periodical information as to how their engines are operating.

Automatic Telephony

By Charles W. Wilman. Second edition, thoroughly revised and reset. Pp. viii+208. (London: The Technical Press, Ltd., 1938.) 10*s*. 6*d*. net.

AUTOMATIC or machine switched telephony is a very specialized subject; but the fundamental principles can be easily grasped. Few relevant text-books indicate these principles without confusing the student with circuit complexities; the author does provide a readable introduction both for students who intend to go further in their studies of the subject and for those who have to include an outline in their general study of electrical communication. The extensive study of the subject is not to be recommended to anyone who has not a suitable flair for the peculiar but necessary diagrammatic nomenclature.

One is surprised that the author does not give a technique for studying complicated switching problems; some form of pictorial shorthand is always used by engineers when studying machine switching circuits or devising new ones. There is likewise no complete circuit, such as a complete call through the minimum of a line-switch and selectors, or a director,

so that the student can have the mental exercise of seeing how the elemental functions, each clearly described with circuits, operate in concord and with economy of apparatus. One would have liked more details of some of the other automatic switching systems in use. We are committed to a Strowger-director system in Great Britain, but other systems, such as the rotary, have special advantages, and are, in fact, largely manufactured here for export. The proportion of telephones in Great Britain which are operated by machine switching is high and is increasing, and no student of electrical engineering can be without some knowledge of the basic ideas. There is little scope for young engineers in automatic telephony, but the inherent principles are widely applicable in many other directions, such as remote-metering and control, traffic-lights, and signalling schemes of all descriptions. L. E. C. H.

Mathematics

Solid Mensuration

With Proofs. By Prof. Willis F. Kern and Prof. James R. Bland. Second edition. Pp. vii + 172. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 10*s*. net.

THIS is practically a new book although a second edition, for not only is it more than twice the size of the original edition, but substantial alterations have also been made in the text by the authors. After an introductory chapter giving suggestions for practical computation and a clear summary of plane mensuration, lines, planes and dihedral angles are dealt with. Then follows a good course on solids of uniform section, pyramids and cones, frusta, prismatoids and the sphere. Later come the theorems of Pappus without proofs and a consideration of polyhedra. Finally, the general prismatoid is discussed and a proof of the prismoidal formula given.

The book is thoroughly well illustrated by clearly drawn figures—a very essential feature for any book on mensuration—and there is an abundance of interesting exercises with a practical bias, including a good set of review problems.

Les géométries

Par Prof. Lucien Godeaux. (Collection Armand Colin: Section de mathématique, No. 206.) Pp. 215. (Paris: Armand Colin, 1937.) 15 francs.

PROF. GODEAUX'S addition to this excellent series of popular monographs, will be found of interest to the general reader and to the specialist. The former will be made familiar with the fundamental concepts of the various types of geometry; and both will learn much about their historical and methodological background. The six chapters of this work deal respectively with elementary geometry, analytical geometry, projective geometry, the principles of geometry, the theory of groups and topology. The mathematical notation used is quite simple, and the book makes easy reading owing to the explanations covering all the difficult intuitions of the geometricians. T. G.

Medical Studies

Research in Medicine and other Addresses

By Sir Thomas Lewis. Pp. viii + 75. (London: H. K. Lewis and Co., Ltd., n.d.) 5*s*. net.

THIS book contains a collection of addresses delivered by Sir Thomas Lewis on various occasions, including the Harveian Oration on "Clinical Science" to the Royal College of Physicians, London, 1933, and the Huxley Lecture on "Clinical Science within the University", at the University of Birmingham, 1935, and all first published in the *British Medical Journal*.

During the last twenty years, Sir Thomas Lewis has made outstanding contributions to medicine dealing with disorders of the heart and circulation.

In the preface to this volume, Sir Thomas says that in his earlier days, when working upon physiological problems, he came to the belief that the problems daily encountered in hospital wards, despite their complexity, are capable of solution by a similar form of investigation, that is, by the experimental method directly applied to man, and he tells us that he has never wavered in this belief and that all his later experience has confirmed it. Actually, this method in Lewis's hands has yielded rich results. A second motif running through these addresses is the hope that a science of medicine might develop through the freeing of investigators from the necessity of earning a livelihood by practice. At the end of his Huxley Lecture he says: "It is my conclusion that it is largely within the power of our universities to establish the branch of work that studies disease in living people as a science, by removing the obligation to engage in and teach the practical art, and by treating Clinical Science on precisely the same basis as the allied sciences, physiology and pathology, are treated, thus bringing all the work into real harmony".

Sufficient has been said to indicate the content of these addresses, and many will probably agree that Sir Thomas has established his thesis.

The Health of the Nation and Deficiency Diseases

By John Maberly. Pp. xi + 118. (London: Baillière, Tindall and Cox, 1938.) 5*s*.

THE author maintains that the physique of the younger generation has steadily declined during the last twenty years in spite of improvement in hygiene, labour conditions, and provision for unemployment and sickness as well as for clinics for child welfare. He attributes the ill-health which is prevalent among a large section of the people, especially in the form of neurasthenia, to partially deficient diets resulting from the present methods of milling wheat and the making of white bread. According to him, the vitamins B and E, as well as iron, iodine and copper, which are contained in adequate amounts in wheat but are either wholly or very largely confined to the germ and cortical layers of the grain, are excluded in the ordinary white bread. He therefore recommends an absolute

lition of the practice of removing the germ and cortical layers of the wheat which at present are given to cattle or poultry, and urges that millers should be compelled to supply flour containing all the nutritious elements of the grain.

The last three chapters, which have no obvious connexion with the rest of the work, are devoted to pernicious anæmia, non-pernicious anæmia and glycosuria and diabetes mellitus respectively.

The Medical Press and Circular, 1839-1939

A Hundred Years in the Life of a Medical Journal. By Dr. Robert J. Rowlette. Pp. x + 127 + 10 plates. (London: Medical Press and Circular, 1939.) 10*s.* 6*d.*

THE *Medical Press and Circular* was founded in Dublin by Dr. Arthur Jacob in January 1839 under the title of the *Dublin Medical Press*. The medical profession was entirely unorganized at the time of its foundation, and Jacob was one of the first to recognize the need for organization. To mark its centenary (see NATURE, Feb. 11, p. 237) Dr. Robert Rowlette, for many years Irish editor, has written this interesting history of the *Journal* and its development, and has woven into his account the medical history of the times.

The *Medical Press* was published in Dublin up to 1866; but in that year it absorbed a London periodical, the *Medical Circular*, founded in 1852 by Dr. James Yearsley, a well-known aural surgeon, and edited by Dr. George Ross during the fourteen years of its existence.

Arthur Jacob was a prominent surgeon in Dublin, and he was the discoverer of the layer of rods and cones in the retina of the eye. He was succeeded as editor by his son, Dr. Archibald Jacob, and the *Journal* then took a close interest in the betterment of the profession employed under the Poor Law system. In the 'nineties, in common with other journals, it pressed for reforms in the Army Medical Services, and in recent years has pursued an editorial policy of providing concise and authoritative articles upon the latest methods of diagnosis and treatment.

Dr. Rowlette's "History" is attractively produced, being printed on cream antique laid paper, and bound in crash canvas with green labels lettered in gold, and is illustrated with ten excellent plates.

Diets for Diabetes

Arranged in Menu Form. By Dr. G. E. Beaumont. Pp. vi + 49. (London: J. and A. Churchill, Ltd., 1938.) 2*s.* net.

IN this short booklet, diets for those suffering from diabetes are presented in menu form, so that the patient need not calculate equivalent food values from tables. Having been informed by his doctor of the amount of carbohydrate, etc., and number of calories appropriate to his condition, the patient may thus select meals suitable for him, and which appeal to his appetite and his taste. First of all, tables are given of the carbohydrate, protein and fat content and calorie value of fruits, vegetables, meats, etc., after which a number of daily menus is set out, each with its dietary constitution and calorific value. The diets suggested commence with a scanty one of only 178 calories and become progressively more and more generous. The information given should be very useful to the sufferer from diabetes, and will alleviate some of his trials.

Viscosity of the Blood

The Cause and Cure of High Blood Pressure. By Major Vincent Nesfield. Pp. 96. (London: R. Cobden-Sanderson, Ltd., 1938.) 5*s.* net.

IN this work, which is based on eight years' research, the author maintains that high blood-pressure is due to increased viscosity or thickness of the blood, for the measurement of which he has devised a special instrument or viscometer.

The chief cause of viscosity of the blood is stated to be over-eating and lack of exercise, which account for its rarity in farm labourers, among whom the author had a practice for more than fifteen years, and its frequency among the well-to-do. Treatment of the condition, therefore, should consist in a reduction of diet and in bleeding, which though carried out to excess in the past has been too much neglected at the present day.

Miscellany

Essential Facts about the League of Nations

Ninth edition (revised). Pp. 349 + 9 plates. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1938.) 1*s.*

THIS admirable but lucid recapitulation of the essential facts about the League of Nations provides an indictment of recent statesmanship which is the more impressive because the book is wholly free from polemics. The bare statement of the achievements of the League, the outline of its contribution to human welfare in many technical fields as well as in the political, make it the more amazing that nationalist policies anywhere should have hampered that continued development and contribution. The immense amount of readable information provided here in pocket form and easy of reference in itself emphasizes the necessity of a return to the League system and the evolution from within its framework of a more perfect structure where required. Only as the principles upon which the League is based are recognized can there be for any nation either the security or the amelioration of economic conditions which in these last few years have been sought increasingly but in vain by very different methods.

Catalogue of Lewis's Medical and Scientific Lending Library

New edition, revised to the end of 1937. Part 1: Authors and Titles. Pp. viii + 550. (London: H. K. Lewis and Co., Ltd., 1938.) 16*s.* net; to Subscribers, 8*s.*

THIS new edition of Part 1 of the Catalogue of Lewis's Medical and Scientific Lending Library has been revised to the end of 1937. It contains the list of authors and titles, estimated to be some twenty thousand in number, of the works in the

Library. All works of any importance, English, American and foreign (when translated), are to be found in the Library, as well as a number of journals, reports and annual reports and year-books. All those who have used this Library know how useful it is, and the subscription rates are very moderate. Part 2, which gives the classified index of subjects, is in active preparation, and is expected to be ready early this year.

English for Students in Applied Sciences

By Prof. S. A. Harbarger, W. R. Dumble, W. H. Hildreth and Prof. Bert Emsley. Pp. xiii+260. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 12*s*.

THIS book outlines a course for American science students in the writing of English. It is thoughtfully written and well produced. Though not entirely suitable in structure or detail for students in Great Britain, it should be found stimulating by their teachers. The average science student's technical knowledge of writing falls far short of his technical knowledge of science, and the difficulty of getting results on paper in a lucid way is often a factor which limits his usefulness as a research man. Many productive workers seem unconscious of the need to examine the bases of composition, or consider the vital relation between author and reader.

A course in English directed to making clear the principles underlying the writing of English, and giving an opportunity for practice in drawing up reports and similar documents, should be of much value in the science courses of English universities. Everyone who has to deal with the preparation of manuscripts for the press or with their subsequent abstraction would be grateful if the universities gave the science student a more deliberate training in this matter. In view of the vast annual output of scientific papers, and the endless labour involved in keeping abreast of them, everything possible should be done to make such papers as clear and understandable as the subject allows. B. S.

The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland

With a Record of Publications issued during Session 1937–1938. Compiled from Official Sources. Fifty-fifth Annual Issue. Pp. vii+169. (London: Charles Griffin and Co., Ltd., 1938.) 10*s*. net.

MESSRS. CHARLES GRIFFIN are to be congratulated on the promptness with which they have issued the 1938 edition of this useful annual. The extent of the volume is about the same as that for 1937, and checking here and there shows that as regards recent changes of address and similar facts it is up to date. The data given include the full names of every society and institution mentioned, its address, officers, conditions of membership and particulars of meetings and publications. Government institutions such as the British Museum, Kew Gardens, Meteorological Office, and so on, are also included. It is worth emphasizing that the volume is "Compiled from Official Sources".

The Roof-Tree

By James Kenward. Pp. xxv+124+26 plates. (London, New York and Toronto: Oxford University Press, 1938.) 8*s*. 6*d*. net.

THIS book traces in a popular and entertaining style the structural development of the dwelling-house. The author has followed its growth from the shelter of a tree, through pre-, proto-historic and historic forms to the multicellular erection of modern type as seen in the rural dwellings of Kent. Although his illustrations are drawn from a single English county, in which his interest centres, the principles exemplified are of general application. He shows how human needs have been met by extension of the primitive structure along lines determined by constructional possibilities and the character of the material available from local resources. As his title indicates, Mr. Kenward deals only with the northern form of European house evolved from a prototype in which the formative element was a wooden structure. His book is written with an infective enthusiasm for craftsmanship and the craftsman.

Chemical Engineering Economics

By Chaplin Tyler. (Chemical Engineering Series.) Second edition. Pp. ix+241. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 18*s*.

THE economic problems of chemical engineering are those of industry in general, varied only in so far as production is based essentially on change in chemical form. The graduate entering industry is very soon confronted with them, and finds them to be of a different character and wider in their ramifications than those he has studied for his degree. It will come as a boon to many to have these economic questions concisely and clearly set out in book form. The author is qualified by his experience for this task, which he has accomplished in a praiseworthy manner: there can be few chemists who will not profit by reading it, even though it applies to American conditions.

The subject is considered under such headings as organization, project analysis, plant location and design, operation control and cost, cost accounting and sales development, whilst the research aspect is not overlooked. The tendency towards continuous or semi-continuous operation is emphasized, which involves the construction of large unit plants to reduce the cost of direct labour and supervision. As a result the capital investment in a chemical establishment tends to be much higher than in industry generally, and manual skill is becoming less important in every branch.

Colour Photography in Practice

By Dr. D. A. Spencer. Pp. xvi+275. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 21*s*. net.

GOOD colour transparencies can now be made on material readily available in most photographic shops. Colour films are frequently shown in the cinemas, and good colour photographs on

paper are obtainable; but except for the first of these the technique is difficult and requires very great resources of knowledge and equipment in order to produce good results with certainty. The commercial use of colour photography for advertising purposes alone has made it worth while to master the difficulties of reproducible technique and to discover the detail of the operation of the principles of colour photography. Success has not been achieved very long, and there are few workers in colour photography who will not be glad to read this book, which reveals so much of the science behind their craft.

Dr. Spencer treats the subject in relation to the existing successful processes of still photography. He omits colour cinematography altogether on account of its complication and the great space which would be needed for its treatment.

The book is divided into four main parts: Part 1 describes general considerations, including the outline of the principles of subtractive and additive colour photography. It contains also a chapter on lighting and another on the use of colour photographs; Part 2 describes in detail the subtractive methods; Part 3 describes, also in detail, additive methods. Finally, Part 4 outlines the accuracy of reproduction attainable, reproduction of colour photographs by modern illustration processes, and æsthetic considerations.

The widely extended commercial application of photography, and to some extent also the resurgence of its popularity as a hobby, have caused the technical classes in various schools to be well attended. The number of entrants for the City and Guilds examinations in photography also is higher than formerly. The need for better text-books is thus very great. The volume under review will probably be regarded for many years as a standard text-book, combining exceptional clarity of exposition with a readable style in a way which is admirable.

Psychology

Psychology in Everyday Life

By Dr. Walter C. Varnum. Pp. xii + 444 + 16 plates. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15*s*.

THIS book is designed for non-professional students of psychology. It will also meet the needs of the inquiring layman.

Written in a perfectly clear and simple style, it presents some of the simpler applications of psychological research in the fields of industry, education and mental health. The author is cautious and restrained, and avoids the sensations and loose generalizations one meets in popular books of this type.

One of the chief merits of the book is that it brings home the utility of much so-called academic experimentation in practical problems. The most satisfactory sections are those on the "Psychology of Learning". Following each chapter is a list of about fifty assertions on topics discussed, which the reader has to accept or reject as a test of his having mastered the contents of the chapter.

The selection of subjects dealt with in a short work of this kind is, on the whole, a judicious one. Although it is full of factual material and a minimum of discussion this book can scarcely be called a text-book of psychology; but is probably an excellent introduction to the subject for the non-technical student.

J. I. COHEN.

Psychology of Music

By Prof. Carl E. Seashore. (McGraw-Hill Publications in Psychology.) Pp. xix + 408. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24*s*.

FROM the preface to this book we learn that it is a logical sequel to the author's "Psychology of Musical Talent". His present purpose is "to stimulate and guide the student of music in scientific observation and reasoning about his art. . . . Since the book is written for beginners, no technical description of apparatus or method is given. . . ." Certainly, good service is done by every book which teaches the student of music that his perceptions of musical sounds are not mere reproductions of their physical causes; but, faced with graphs of pulsating frequencies and intensities in a melodic line of music, as performed, the serious student will ask questions that are left unanswered by the author's decision to omit these technical descriptions. The physicist will want to know the nature of the response of the recording instruments, and how they were calibrated. The musician will want to know whether the melodic line was unaccompanied; and, if not, how it was related to its musical context. His question is fundamental; for the foundation of the art of music, as we know it, lies in polyphony.

Seventy-five years ago, Helmholtz directed attention to our ignorance of the psychological section of the theory of hearing. The studies reviewed in this book show how much we have still to learn before the whole story can be told. Meanwhile, not all musicians will accept the whole of the author's postulates as axioms. The book contains a lengthy bibliography, including the titles of papers to which the author refers.

LL. S. L.

Intuition

By K. W. Wild. Pp. vii + 240. (Cambridge: At the University Press, 1938.) 10*s*. 6*d*. net.

MISS WILD is to be congratulated on a very readable and careful account of intuition. The whole subject is fraught with difficulties and pitfalls, and it is startling to be presented with thirty-one definitions of intuition.

We cannot help but feel that intuition is in some cases the result of pure chance—when it is regarded as "an abnormal method of knowing based neither on the senses nor on deduction and inexplicable as to its working". There is, as the author wisely points out, much room for research, and possibly the final result of the research may be that there is no such thing as intuition, as some writers would like us to believe about instincts.

Forthcoming Books of Science

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D. Appleton-Century Co., Inc. Application of Chemistry to Agriculture. C. C. Hedges and H. R. Brayton.

Jonathan Cape, Ltd. The Genetics of Cotton—Dr. S. C. Harland.

Country Life, Ltd. Farming Restored—edited by C. Turnor. The Flowering Shrub Garden—M. Haworth-Booth. Twentieth Century Gardening—C. Eley.

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Announcements

PROF. F. G. DONNAN, emeritus professor of chemistry in the University of London, has been elected an honorary member of the Société Philomathique of Paris. This Society was founded in 1788.

THE following have been elected honorary members of the Royal Meteorological Society: Jules Jaumotte, director of the Royal Meteorological Institute of Belgium, Uccle, near Brussels; Prof. Carl-Gustaf Rossby, professor-in-charge of the Meteorological Department, Massachusetts Institute of Technology; Philippe Wehrlé, director of the National Meteorological Office of France.

THE Hillebrand Prize for 1938 of the Chemical Society of Washington has been awarded to Raleigh Gilchrist and Edward Wichers, of the U.S. National Bureau of Standards, for their paper entitled "A New System of Analytical Chemistry for the Platinum Metals," presented before the Ninth International Congress of Pure and Applied Chemistry at Madrid.

PROF. EGON RITTER VON SCHWEIDLER, hitherto general secretary, has been made vice-president of the Vienna Academy of Sciences, and Prof. Ernst Spath has succeeded him as general secretary.

A CHAIR of aerology has recently been instituted in the University of Rome and to it will be attached a laboratory for studies and researches in aerology. The first occupant of the chair is Prof. Filippo Eredia, whose address is Istituto di Aerologia, Via Emilo de' Cavalieri, 7 Rome, 106.

DR. BERNARD H. KNIGHT, lecturer in roadmaking in the College of Estate Management, London, has been recently appointed senior research assistant in highway engineering in the University of the Witwatersrand, Johannesburg.

COMPENSATION has recently been made for the use of the University of Bristol botanic garden for building purposes by the provision of another site on the Royal Fort estate. The new garden will be known as the Hiatt Baker Botanic Garden.

THE centenary meeting of the Royal Microscopical Society will be held on October 25–26. Further information will be available later from the Secretary, Royal Microscopical Society.

THE next meeting of the International Society of Cosmobiology will be held during April 9–11 at Mentone. Further information can be obtained from the general secretary, Dr. Maurice Faure, 24 rue Verdi, Nice.

THE Netherlands Congress of Natural Sciences and Medicine will be held at Nymwegen on April 11–13 under the presidency of Prof. G. Holst. Further information can be obtained from the general secretary, Dr. D. Collingh, Regentesselaan, 2, Bussum.

THE eighteenth International Congress of Agriculture will be held in Dresden during June 6–12, when the following subjects, among others, will be discussed: agronomy, crop production, disease, etc.; vines, fruits and special crops; agricultural industries; agricultural research. Further information can be obtained from the general secretary, Dr. F. Sohn, Hafenplatz 4, Berlin, S.W.11.

A PRIZE of £20 and a diploma are awarded annually by the Royal Asiatic Society for an essay, the object being to encourage interest in the history and civilizations of the East among non-Asiatics. It is confined to members of certain universities. Further information concerning subjects for 1939 can be obtained from the Secretary, Royal Asiatic Society, 74 Grosvenor Street, London, W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 438.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The 'Failure' of Quantum Theory at Short Ranges and High Energies

IN Dr. Bhabha's letter in NATURE of February 18, reference is made to a breakdown of quantum theory at high energies and short intervals. This seems to be widely interpreted as setting a limit to the validity of our present physical conceptions. Some indeed would associate it with a fundamental discontinuity of structure of space and time. I have no occasion to criticize Dr. Bhabha's letter which, so far as it goes, is opposed to the more extreme interpretations. But I venture to suggest that an unnecessary mystery is being made of what is really an elementary point of relativity theory. In short, we know why the present theory has got into difficulties, and we know what must be taken into account if it is to get out of them.

Relativity theory begins with a denial of absolute motion. Every observed velocity dx/dt is a relative velocity of two physical objects. Likewise the 'x' of which velocity is the time-derivative is a relative displacement of two physical objects. Both objects are connected with the space-time frame in the way pointed out by Heisenberg; namely, they are not locatable as points (or, in four dimensions, world-lines) but have an uncertainty of position and momentum.

Usually dx/dt and x are assigned to one of the objects (here called the object particle), the other being regarded as a reference body. In precise formulæ, the reference body must evidently be a particle. The reference particle is then the physical 'origin' from which the observable co-ordinate x of the object particle is measured. Current quantum theory has repeated the pre-relativity mistake of paying insufficient attention to the definition of the physical reference system to which its exact formulæ are intended to apply. It enunciates formulæ involving x and $\partial/\partial x$, but omits to specify the standard deviation (uncertainty) of position and momentum of the origin from which x is measured. Clearly, the formulæ cannot be true for an arbitrary standard deviation; if true at all, they must hold for a particular standard deviation of position ε which ought to have been specified. Since there is no explicit reference, the actual value of ε must be implicit in the empirical constants (such as h/mc) of the quantum formulæ.

When two object particles with co-ordinates x_1 and x_2 are considered, the displacement ξ_0 of one relative to the other is observable independently of any origin of co-ordinates, being the original observable called 'x' in our second paragraph. This must not be confused with the co-ordinate difference $\xi = x_2 - x_1$, which introduces twice over the uncertainty of the physical origin from which x_1 and x_2 are measured. We have (in the notation of the theory of errors)

$$\xi = \xi_0 \pm \varepsilon\sqrt{2}.$$

The failure of current theory is due especially to its omission to distinguish the two observables ξ and ξ_0.

The physical origin has uncertainty both of position and momentum; for if either were zero the other would be infinite, and the physical origin would not approximate to a geometrical origin with a definite world-line. An energy m_0c^2 corresponding to the mean square of the uncertain momentum is therefore associated with the origin. Except in two-body problems (in which one object particle is used as physical origin for the other) the practice is to treat all the object particles symmetrically; the physical origin must then be an additional *virtual* particle, that is, a particle inserted in the system as part of the apparatus of measurement, but not counted among the object particles, and only taken into account as representing the disturbance of the system which the carrying out of a measurement implies. The energy m_0c^2 belongs to the physical origin contemplated as a virtual particle, and gives it a proper mass m_0. In order that quantum equations may be definite, the uncertainty constants ε and m_0 of the physical origin must have standard values.

Naturally physicists who have neglected the uncertainty ε of the origin will find that their equations break down at distances of order ε. Nothing has gone wrong with space; it is the theorists who have failed to apply their own principles in relating the observable physical system to space. To state their failure summarily: there are two recognized principles of observability, namely, the quantum principle that an observable *object* has an uncertainty relation to the geometrical space-time frame, and the relativity principle that an observable *quantity* relates to two observable objects. Current theory recognizes these principles separately but not in combination; and in dealing with co-ordinates and momenta it pays attention only to the uncertainty at the object-particle end of the relation.

The remedy is obvious. I do not say that the application of the remedy is an easy matter; but, if it is clearly the thing most worth doing, that will not deter anyone. An astronomer, unable to solve his own 'problem of three bodies', can only admire the success with which physicists tackle the more numerous closely interacting particles of the nucleus. But I think the advance would not be less rapid or less substantial if they gave up using the wrong formulæ. My own work[1] (chiefly concerned with the momentum uncertainty m_0) has been confined to extra-nuclear problems; no insuperable difficulty has appeared, though progress has not been easy.

I turn now to the actual values of ε and m_0. A geometrical frame of space-time is not a physical reference system, since its exactitude is incompatible with observability. (To assign infinite mass to the frame, so as to make both its position and velocity exact, would introduce infinite curvature, and defeat its use in a different way.) We turn it into a physical

frame by associating with it uncertainty constants, namely, a particular length ε and a particular mass m_0. (In mathematical treatment we should assign to the frame a wave function describing a probability distribution corresponding to these constants.) These 'put the scale into' physical systems, and all other natural lengths and masses will stand in a definite numerical ratio to them. Since we observe only relative scale, the arbitrariness of the initial choice of ε and m_0 is eliminated. From extra-nuclear investigations I have found that m_0 is 10/136 of the mass of a hydrogen atom; and ε, which is very simply related to certain magnitudes calculated in cosmological theory[2], has the value $1{\cdot}10 \times 10^{-13}$ cm. (For technical reasons, the constant more usually given is $k_0 = 2\varepsilon = 2{\cdot}20 \times 10^{-13}$ cm.)

That the virtual particle of mass m_0, originally studied in extra-nuclear theory, is the particle now used in nuclear theory under the name of 'mesotron', or 'meson', admits, I think, of no doubt. But whether the usual assumption is correct, that nuclear mesotrons are the same as the actual mesotrons observed in a Wilson chamber, I have no means of judging. Since m_0 and ε are conjugate, it is optional which we treat as the more fundamental; but I would point out that to proceed *via* the mesotron mass is a roundabout way of getting at the range of nuclear forces, since the range is an immediate manifestation of the uncertainty of position of the origin. The nuclear force between two protons comes from an energy-singularity occurring when two protons coincide—a sink which (in uniform distribution) just compensates the Coulomb energy occurring when they do not coincide. The condition of coincidence $\xi = 0$ gives $\xi_0 = \pm \varepsilon\sqrt{2}$, which (for the calculated value of ε) agrees exactly with the range of force found by Breit, Condon and Present in their discussion of the scattering of protons.

A. S. EDDINGTON.

Observatory,
Cambridge.
Feb. 27.

[1] Eddington, "Relativity Theory of Protons and Electrons", Chapters xi, xii.
[2] Eddington, *Proc. Roy. Soc.*, A, **162**, 155 (1937).

Variation of Field Penetration with Temperature in a Superconductor

WE have recently completed an investigation of the magnetic threshold fields for thin superconducting films of mercury. The extended magnetic transition curves described in a previous communication[1] have been removed by using in place of a strip of film a circular disk with embedded current and potential leads. In this way, effects due to the diminishing thickness of the film at the edges of a strip are eliminated.

Fig. 1 gives an example of the results obtained. The left-hand scale of ordinates gives the values in gauss of the critical field at half-height at different temperatures for a film $1{\cdot}2 \times 10^{-5}$ cm. in thickness. The right-hand scale gives the corresponding values of H_f/H_c, where H_f is critical field for the film and H_c is critical field for bulk mercury. To give an idea of the consistency of the results, values for successive films are plotted with different symbols. Values are included for films deposited at various temperatures

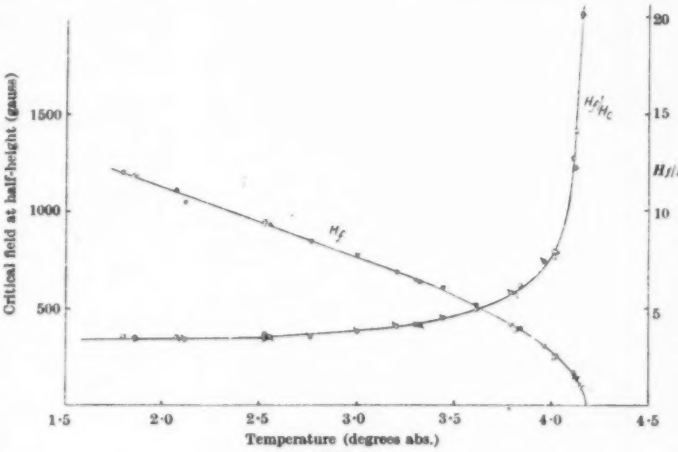

Fig. 1.

and afterwards annealed to different degrees. The agreement shows that we are here dealing with a true size-effect independent of structure.

It can be seen that the field-ratio H_f/H_c rises very steeply in the neighbourhood of the transition temperature and that it seems likely to approach infinity at that point. Unfortunately, there is no complete theory of the threshold fields for superconductors of small dimensions, but it is generally accepted that the critical field will increase rapidly when the conductor becomes comparable in thickness with the depth of the field penetration. We conclude from our experimental results that the field penetration is not constant, but that it increases rapidly near the transition point and may even become infinite there.

In default of an explicit formula, we may assume

$$\frac{H_f}{H_c} = f\left(\frac{d}{\lambda(T)}\right),$$

where d is the thickness of the film and $\lambda(T)$ is a parameter (of the dimensions of a length) which defines the field distribution inside the superconductor.

If we now take two films of thicknesses d_0 and d and find two temperatures T_0 and T at which the values of H_f/H_c are the same, we have:

$$\frac{d_0}{\lambda(T_0)} = \frac{d}{\lambda(T)}, \quad \text{or} \quad \frac{\lambda(T)}{\lambda(T_0)} = \frac{d}{d_0}.$$

In this way, from a series of experimental curves for film thicknesses varying by a factor of 50, we have built up a rough curve giving the relative values of $\lambda(T)$ at different temperatures. Fig. 2 shows a curve so obtained. Ordinates are ratios of field penetration at any temperature to field penetration at 2·5° K. With one or two doubtful exceptions the points fit on a smooth curve.

If we accept a theory of the London[2] type, this result can be most simply explained by assuming that the number of electrons responsible for superconductivity is small or zero at the transition point and increases rapidly as the temperature is lowered. A similar suggestion was advanced by Gorter and Casimir[3] some years ago to account for the specific heat anomaly at the transition point.

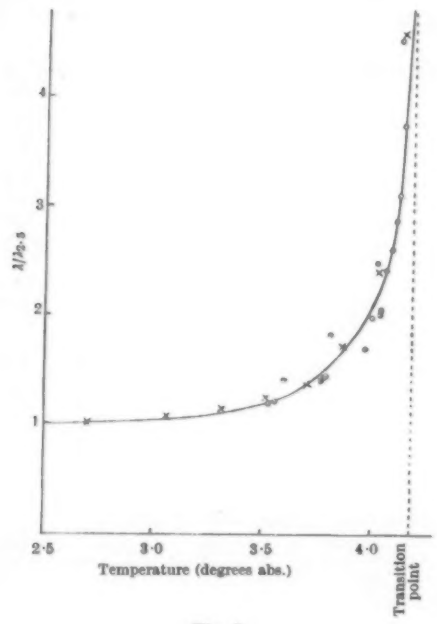

Fig. 2.

○, APPLEYARD, BRISTOW AND LONDON.
×, SHOENBERG'S RESULTS. (See letter below.)

The absolute magnitude of the field penetration can be estimated by making certain reasonable thermodynamic assumptions. With an exponential type of field-distribution, we obtain the relationship

$$\frac{H_f}{H_c} = 1 + \frac{\lambda}{d}$$

for very thick films.

Our results are in agreement with this expression and give a value $\lambda = 1{\cdot}2 \pm 0{\cdot}1 \times 10^{-5}$ cm. at 2·5° K., which is of the same order as the rough estimate made by Pontius[4] using thin wires of lead.

E. T. S. APPLEYARD.
J. R. BRISTOW.
H. LONDON.

Royal Society Mond Laboratory,
Cambridge,
and
Wills Physical Laboratory,
Bristol.
Feb. 6.

[1] Appleyard and Misener, NATURE, 142, 474 (1938).
[2] London, F. and H., *Proc. Roy. Soc.*, A, 149, 71 (1935).
[3] Gorter and Casimir, *Phys. Z.*, 35, 965 (1934).
[4] Pontius, *Phil. Mag.*, 24, 787 (1937).

Superconducting Colloidal Mercury

THE magnetic properties of some colloidal mercury preparations have been investigated by a ballistic method, and provide direct evidence for the existence of a small penetration depth of a magnetic field into a superconductor, and for a temperature dependence of this penetration of the same kind as observed by Appleyard, Bristow and London[1]. From the initial slope of the magnetization curve, the magnetic

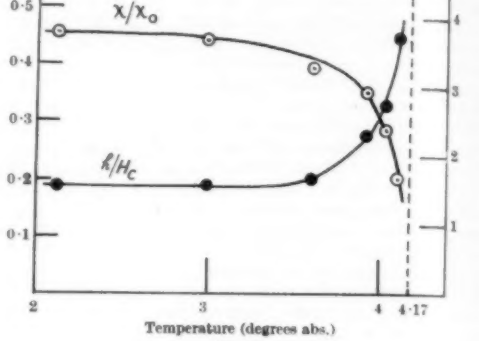

Fig. 1.

moment per unit field per unit volume of mercury (χ) can be deduced for the small spherical particles of the colloid, and this was found to be appreciably smaller numerically than the value $\chi_0 = -\frac{1}{3\pi}$ for a large sphere (in which the penetration of the magnetic field is relatively negligible), and to decrease with increasing temperature towards the transition temperature (4·17° K.). This is illustrated in Fig. 1,

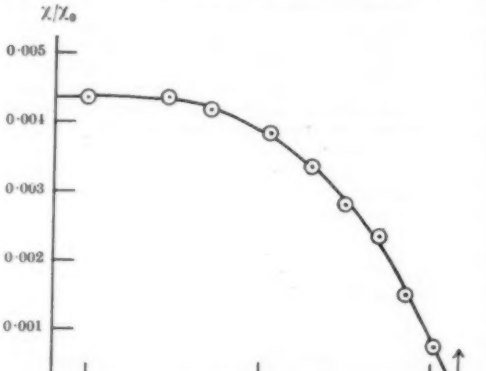

Fig. 2.

which shows the temperature variation of χ/χ_0 for a colloid of mercury in gelatine (average particle diameter of order 10^{-4} cm.). From the magnetization curves, the critical field h was also obtained, as the field at which the magnetization disappeared, and as in the case of thin wires[2] and thin films[3], h was larger than the bulk critical field H_c; the temperature dependence of h/H_c is shown in Fig. 1.

The fact that χ/χ_0 is less than 1 can be immediately interpreted as due to a penetration of the magnetic field into the particles, to a depth comparable to the particle size, while the fact that χ/χ_0 decreases with increasing temperature must mean that this penetration increases. It will be seen that h/H_c increases just in the region where χ/χ_0 is decreasing, thus confirming the inference of Appleyard, Bristow and London[1] that this increase is associated with an increasing penetration depth. Similar results were obtained with an emulsion of mercury in chalk, but the effects were less pronounced owing to the larger average particle size.

Measurements were also made with a colloid of mercury in albumen in which the particle size was about ten times smaller than for the gelatine colloid, and the values of χ/χ_0 were now extremely small (Fig. 2), showing that the penetration of the field was almost complete. The critical fields, however, were so large that they could not be reached with the largest field used (900 gauss) even at the highest temperature.

If the law of falling-off of magnetic field into the surface of a superconductor is known, the value of χ/χ_0 can be calculated as a function of r/λ, where r is radius of the sphere, and λ the penetration depth. The London theory[4] assumes the law to be according to the differential equation $\nabla^2 H = H/\lambda^2$, and with this assumption it has been shown[5] that

$$\chi/\chi_0 = 1 - 3\left(\frac{\lambda}{r}\right) \coth \frac{r}{\lambda} + 3\frac{\lambda^2}{r^2}, \qquad (1)$$

which for $r \ll 1$ reduces to

$$\chi/\chi_0 = \tfrac{1}{15}\, r^2/\lambda^2. \qquad (2)$$

Assuming this formula, we have calculated $\lambda/\lambda_{2\cdot5}$ as a function of temperature for the albumen colloid, and as can be seen from Fig. 2 of Appleyard, Bristow and London's note, the results agree quite well with those from the thin mercury films, suggesting that equation (2) is of the correct form. At present only the order of magnitude of the average value of r^2 is known, so the absolute value of $\lambda_{2\cdot5}$ cannot be given exactly; it agrees, however, in order of magnitude with the thin film estimate. It will be noticed that close to the transition point, T_0, χ/χ_0 decreases linearly with $T_0 - T$, which means that the penetration depth becomes infinite at $(T_0 - T)^{-1/2}$.

In the case of the larger particles, as in the gelatine colloid and the chalk emulsion, the London assumption cannot be tested exactly, since the lack of uniformity of particle size complicates the application of equation (1); this complication does not arise in the case of particles so small that equation (2) can be used. It is hoped to overcome this difficulty by working with a more uniform preparation of known particle size.

In conclusion, it is a pleasure to thank Mr. R. T. M. Haines, of British Colloids, Ltd., for preparing the colloids used in these experiments.

D. SHOENBERG.

Royal Society Mond Laboratory,
Cambridge.
Feb. 6.

[1] Appleyard, Bristow and London, see letter above.
[2] Pontius, *Phil. Mag.*, **24**, 787 (1937).
[3] Shalnikov, NATURE, **142**, 74 (1938); Appleyard and Misener, NATURE, **142**, 474 (1938).
[4] London, F. and H., *Proc. Roy. Soc.*, *A*, **149**, 71 (1935).
[5] London, F., *Physica*, **3**, 450 (1936). von Laue, *Ann. Phys.*, **32**, 253 (1938).

Atomic Nuclei in Primary Cosmic Radiation

IT is generally assumed that the mesotrons in cosmic radiation are produced by primary electrons in the upper atmosphere, but there seems as yet not to be any direct evidence for such a process. On the contrary, experiments by Jánossy[1] indicate that electrons cannot produce mesotrons with a probability sufficient to account for the intensity of the mesotronic component.

According to a recent theory of the origin of the cosmic rays[2], these are likely to constitute a more or less fair sample of the charged particles in the neighbourhood of the stars (especially the double stars). This means that the primary cosmic radiation is likely to contain electrons but also a considerable fraction of atomic nuclei with very high energies.

The number of protons or other nuclei observed at sea-level is, however, very small. This might be accounted for by the assumption that incident high-energy nuclei are strongly absorbed when colliding with nuclei in the atmosphere. Such an absorption could be due to a nuclear correspondence to the *Bremsstrahlung*[3], which would imply that it is accompanied by the emission of mesotrons. This would explain the origin of the mesotrons in cosmic radiation at the same time. Processes of this kind must be accompanied by nuclear explosions of the kind observed especially at high altitudes. As the frequency of the explosions increases extremely rapidly with the altitude, it is improbable that they are caused by the mesotronic or electronic components.

In order to fit observations, the nuclear absorption cross-sections in air must be at least $\sim 2 \times 10^{-25}$ cm.^{2} which at the energies concerned corresponds to $1{\cdot}4 \times 10^{-26}$ cm.^{2} in hydrogen. For the latter, Euler and Heisenberg[3] give as a preliminary theoretical value $\sim 10^{-26}$ cm.^{2}.

HANNES ALFVÉN.

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Stockholm 50.
Feb. 6.

[1] Jánossy, L., *Proc. Camb. Phil. Soc.*, **34**, 614 (1938).
[2] Alfvén, H., *Z. Phys.*, **107**, 579 (1937); Compare *Phys. Rev.*, **54**, 97 (1938).
[3] Euler, H., and Heisenberg, W., *Erg. d. ex. Naturw.*, **17**, 30 (1938).

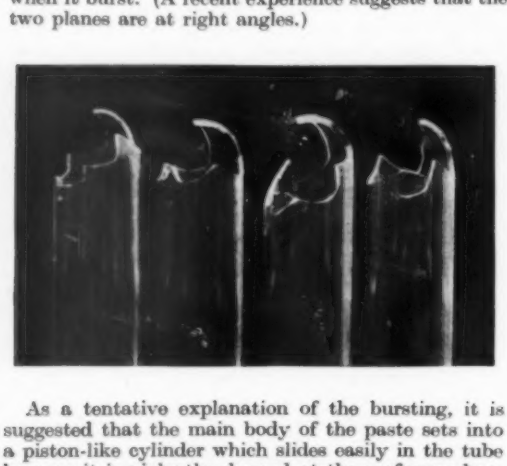
Bursting of Glass Tubes by Thixotropic Pastes

IN a test for the liquid absorption of light powders, water is gradually added to the powder in a hard-glass thick-walled test-tube fitted with a rubber bung. This is shaken between additions by giving several successive brisk taps each with the closed and the stoppered ends downwards on to a rubber pad until a paste is produced which flows out under certain standard conditions. The tubes, of 155 mm. length and 22 mm. bore, are about half full at the completion of the test.

Occasionally, while tapping the tube stopper downwards, the end of the tube bursts outwards and the main bulk of the paste is violently thrown a considerable distance as a single blob. The pastes are strongly thixotropic (false-bodied) and the bursting occurs at the stage when the paste appears quite fluid during shaking but sets rapidly and will not flow out. On these occasions the operator is not sensible of having used excessive force; indeed,

there is a feeling of surprise that such an effect should be produced by a relatively light action. It is significant also that during tapping a sharp click, resembling the impact of a column of mercury on the end of an evacuated tube, is sometimes heard. This is especially noticed when the paste is shaken down to one end and the tube then inverted and tapped with this end uppermost. This sound cannot be produced with water only in the tube, neither is it possible using reasonable force to burst such a tube containing water.

A singular feature is that in the cases we have noticed the type of fracture is always the same and, as will be observed from the accompanying photograph of four tubes collected in 1938, has a symmetrical character. The first three are Monax and the fourth, on the left, is of combustion quality hard glass. The similarity of fracture reflects the directional properties of the forces acting on the different occasions, and since the tubes are well annealed it is presumed that the axis of symmetry of the fractures is related to the plane in which the tube was moving when it burst. (A recent experience suggests that the two planes are at right angles.)



As a tentative explanation of the bursting, it is suggested that the main body of the paste sets into a piston-like cylinder which slides easily in the tube because it is violently sheared at the surfaces where it becomes fluid—a characteristic of thixotropic pastes. This piston slides downwards on impact and then, absorbing the energy of the blow, rapidly returns as a whole to the upper end. Since the pastes have very high yield values, the piston has considerable strength and is presumably rigid enough to prevent air 'blowing' through it. Thus effectively all the air is confined to the lower end, leaving a vacuum in the upper space, so that the piston on returning to this end impacts violently without the cushioning effect of the air film. Such an impact would be absorbed by the rubber bung, but the rigidity of the glass is such that bursting occurs when the closed end is uppermost.

It would be interesting to design an impact apparatus to test our suggestion as to the importance of the type of paste and to measure the forces involved, but at the moment we have no time to pursue the matter further.

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Feb. 8.

Flavin Component of the Pyruvic Acid Oxidation System

EVIDENCE for the earlier suggested[1] participation of a flavin compound in pyruvic acid oxidation by *Bacterium Delbrückii* has been obtained by a procedure similar to that used by Warburg and Christian[2] to remove the prosthetic group (flavin-adenin dinucleotide) from amino-acid oxidase. Phosphate extracts derived from the lactic acid bacteria were repeatedly precipitated with 50 per cent ammonium sulphate at *p*H 3 at 1–2° C. By this treatment a protein fraction was obtained, which on addition of thiamin (vitamin B_1) pyrophosphate only[3], did not catalyse pyruvic acid oxidation, but did so on addition of thiamin pyrophosphate together with flavin-adenin dinucleotide, kindly supplied to me by Prof. O. Warburg.

In the following experiment, 1 ml. of protein solution, corresponding with 0·1 gm. of dried bacteria, was shaken with air for 30 minutes at 37° in the presence of 0·1 mol. pyruvate:

Thiamin pyrophosphate ..	—	15γ	15γ
Flavin-adenin dinucleotide ..	20γ	—	20γ
Oxygen used (ml.)	15	5	248

Riboflavin and the 'old' yellow enzyme were inactive.

In the light of our hypothesis that thiamin when acting as codehydrase is reduced reversibly[3], it is not surprising to find the insertion of a flavin compound between the assumed α-dihydrothiazole and oxygen. We know from the work of Warburg, of Karrer and of v. Euler that compounds of this type (for example, the dihydropyridines) are not autoxidizable, but do easily reduce flavin, which in turn is autoxidizable. Also, it seems significant that in the animal cell the same flavin-adenin dinucleotide has been found[4,5] to be the prosthetic group of diaphorase[6] (coenzyme factor[7]), the carrier between pyridine coferments and cytochrome.

This work was supported by the Ella Sachs Plotz Foundation.

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Feb. 9.

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[4] Straub, NATURE, **143**, 77 (1939).
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[7] Dewan and Green, *Biochem. J.*, **32**, 626 (1938).

Present Condition of a Twelve-Year Old Pure Strain of Carcinoma Cells *in vitro*

ON February 23, 1927, five small fragments of a mouse adenocarcinoma (Frankfurt strain of Ehrlich) were cultivated as hanging drop cultures[1]. With slight modifications, the culture medium used has remained practically the same throughout this period of twelve years. The medium used for cover-glass cultures consisted of one volume of a plasma mixture (equal parts of chick and rat plasma) and one volume of embryonic tissue juice of chick. For cultures in Carrel flasks, the solid medium was composed of equal parts of dilute chick and rat plasma coagulated by a drop of embryonic tissue juice; the supernatant liquid phase, 0·5 c.c., consists of 20 per cent embryonic tissue juice (chick), 20 per cent rat serum and 60 per cent 'Tyrode' solution.

The original five fragments have multiplied to almost 100,000 cultures during the twelve years, and many of these cultures have been used for experiments of various kinds[2]. A few cultures have been grown as hanging drop cultures. To these cultures, there was added from time to time small fragments of normal mouse tissue, which was then invaded by carcinoma cells. Most of the cultures were kept in flasks as a pure strain without addition of normal tissues. The flask cultures have undergone more than eight hundred passages, each averaging three weeks. Regardless of seasonal variations in the takes of the carcinoma cells inoculated from time to time on animals, in order to test their malignancy, it may be stated that the malignant properties of the cells have remained almost constant during the period of cultivation (about 75 per cent). The rate of growth of the cultures also remained constant. The main experiments carried out with this strain concerned the study of the required nutritional condition of the cells compared with that of normal cells and measured as differences in rates of growth. These investigations, we believe, have contributed to the explanation why tumour cells are able to grow indefinitely among the dormant healthy cells in the body[3].

The study comprised investigations of the invasive growth in homologous and heterologous tissues; the humoral and cellular growth principles; the interaction of normal and malignant tissue cells; the influence of the hydrogen ion concentration; the effect of the oxygen tension on the growth; the effect of X-rays and radium; studies on the metabolism; studies on the chromosomes.

It may thus be regarded as a fact that the malignant character of cancer cells is an inherent property, which is maintained indefinitely, even when the cells are cultivated on media derived from animals in which they are not able to multiply. The carcinoma cells have remained mouse cells, besides maintaining the property of cancer cells, and have been able to synthesize their own specific cytoplasm of substances contained in this particular heterologous medium.

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Jan. 24.

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Vascular Supply of the Stamens and Ovules of *Gloriosa superba*

THE study of the vascular anatomy of the flower of *Gloriosa superba* Linn., a liliaceous plant common in India and neighbouring tropical countries, has revealed the occurrence of vascular structure in the stamens and ovules, which is both unusual among angiosperms and of much phylogenetic significance.

The stamen has a single collateral vascular bundle in the young stage, as in the flowering plants in general, but this shows intrafascicular cambial activity of an unusual kind, even though the plant is a monocotyledon. The cambium is irregular in its activity. It forms xylem to the inside and phloem to the outside at the sides of the bundle; but in the middle region it forms only parenchyma quite similar to the ground tissue of the stamen. The single original bundle thus becomes divided into two. By further secondary growth of the same type, each of these daughter bundles may bifurcate again. Thus two, three or four collateral bundles may be formed in the filament of a stamen. The structure is represented in Fig. 1, which shows the transverse section of a filament with a small strand of primary xylem and three collateral bundles. One of these is larger and lies on one side of the median line, while the other two are smaller and lie on the other side of the median line.

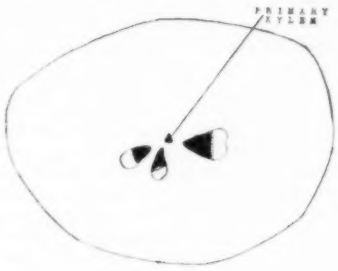

Fig. 1.

Gloriosa superba. TRANSVERSE SECTION OF THE FILAMENT OF A STAMEN.

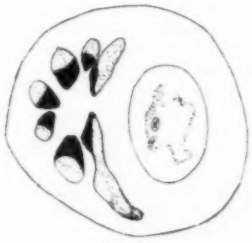

Fig. 2.

Gloriosa superba. TRANSVERSE SECTION OF AN OVULE ABOUT THE MIDDLE.

The above behaviour of the vascular bundle of the stamens of *Gloriosa superba* can be the result of recent specialization, but since intrafascicular cambial activity among monocotyledons is a vestigial character, it is more probable that this repeated bifurcation of the staminal bundles as the result of secondary growth is also a vestigial character. It indicates that the stamen has been derived from a dichotomously dividing branch system bearing terminal sporangia, a view which has been put forward recently by Wilson[1] from the study of the vascular supply of stamen fascicles of Parietales and Malvales and by Thomas[2] from palæobotanical evidence.

The structure of the ovule of *Gloriosa superba* is peculiar in that the single ovule trace divides repeatedly and its branches spread out to form a nearly complete ring of vascular bundles in the raphe (Fig. 2). This is most probably evidence of the axial nature of the raphe and the ultimate derivation of the carpel from a branch system in which the ovules terminated the last branches.

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Jan. 25.

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Experimentally Induced Restricted Paramnesias

THE phenomenon of *déjà vu* has attracted considerable attention from time to time, but no attempt has hitherto been made to subject it to experimental scrutiny. In the course of an investigation of paramnesia, however, we have succeeded in inducing by experimental means states of consciousness virtually identical with this phenomenon. We have further shown that the familiar paramnesias of daily life may be artificially duplicated under the conditions of the laboratory.

Our method was briefly as follows: On the first day of the experiment, coloured postcards and olfactory stimuli were presented to the subject in the waking state. On the following day he was hypnotized, and other similar material presented. Concurrently, suggestions were given to the effect that he would forget all about the latter and be totally unable to recognize it after awakening. In other words, a selective post-hypnotic amnesia was induced. On the third day, the subject was given a recognition test in the waking state. This involved re-presentation of all the items which had been given on the preceding two days together with other similar cards and odours. The subject, an undergraduate student of psychology entirely ignorant of the purpose of the experiment, was instructed to describe his reactions as fully as possible.

Our results clearly prove that restricted paramnesias may be induced by experimental means. The stimuli presented during hypnosis gave rise in every case to a condition virtually identical with localized *déjà vu*. They invariably initiated powerful feelings of familiarity, and these, in their turn, seemed to compel the subject to seek an explanation of the familiarity in terms of concrete past experience. He was generally able to relate the material to some experience, or combination of experiences, in his past history; but in no case did he suggest that there might be a connexion between the experiences of familiarity and the events of hypnosis. His explanations can thus be treated as examples of constructive rationalization.

We may conclude that the impression of familiarity typically arises under conditions in which a cognitive reaction between present and past experience cannot be subjected to introspective scrutiny. It carries with it a powerful tendency to recall the antecedent experience and thereby to render the recognition more explicit. Under conditions in which this cannot be accomplished, the subject is liable to accept a purely constructive interpretation as the basis of the experienced familiarity. Our results are thus in line with the views of MacCurdy[1] and others who seek an explanation of *déjà vu* in the activation of an unconscious cognitive process. It is hoped that further investigation will enable us to evaluate more fully the significance of these results for general psychological theory.

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[1] MacCurdy, J. T., "The Psychology of Emotion", Chap. 43. (London: Kegan Paul, etc., 1925.)

Points from Foregoing Letters

SIR ARTHUR EDDINGTON attributes the failure of current quantum theory at short ranges and high energies to its neglect of the uncertainty of position and momentum of the physical origin from which the observables are measured. The mesotron introduced in theoretical studies of the nucleus appears to be identical with the mass m_0 (10/136 of the mass of a hydrogen atom) already used in extra-nuclear investigation to represent the uncertain momentum of the origin. The range of nuclear forces directly represents the uncertainty of position.

Dr. E. T. S. Appleyard, J. R. Bristow and Dr. H. London report measurements of the critical magnetic fields for thin superconducting mercury films. The ratio of the critical field for a film of given thickness to that of bulk mercury at the same temperature increases steeply as the transition point is approached; from this it is inferred that the field penetration into a superconductor is not constant but likewise increases rapidly close to the transition point. The value of the penetration depth at 2·5° K. is estimated to be $1{\cdot}2 \times 10^{-5}$ cm.

Dr. D. Shoenberg finds that the diamagnetic moment per unit volume of a superconducting particle in a mercury colloid is less than that of a large sphere in the same field, and decreases with increasing temperature, just where the ratio of the critical field to that of the bulk metal increases. This is interpreted as due to an appreciable penetration of the field into the small particles, the penetration depth increasing with temperature. The effects were most marked in a colloid of particle size of order 10^{-5} cm.

According to a recent theory of the origin of the cosmic radiation, this must contain electrons and atomic nuclei. It is pointed out by Dr. H. Alfvén that the nuclei might be stopped in the upper atmosphere through production of mesotrons.

On some occasions when a thixotropic paste is vigorously shaken in a glass tube, G. W. Cowdrey and M. L. Smith find that the end of the latter has burst outwards. Different tubes when burst in this manner exhibit striking similarity of fracture. An explanation based on the phenomenon of thixotropy is suggested.

It is reported by Dr. F. Lipmann that pyruvic acid oxidation in *Bacterium Delbrückii* is catalysed by the combined action of two enzymes, with vitamin B_1 pyrophosphate and a flavin compound as the respective prosthetic groups.

Cancer tissue from the mouse, cultivated for twelve years *in vitro*, still retains its original malignant properties, according to Prof. A. Fischer and Fanja Davidsohn. The carcinoma cells remain mouse cells besides retaining the properties of cancer cells, although they have been grown on a foreign medium (chick and rat plasma and embryonic tissue juice of chick).

An experimental attack is being made on the problems of paramnesia by means of hypnosis, by Dr. H. Banister and O. L. Zangwill. Picture postcards and odours, presented to the subject under hypnosis, later give rise to strong feelings of familiarity, apparently identical with localized *déjà vu*.

Research Items

Painted Skulls from Northern Australia

D. F. THOMSON, who was recently engaged in observing conditions among the aborigines of Northern Australia on behalf of the Federal Government, figures and describes in *Man* of January two painted skulls, which were obtained by him in north-east Arnhem Land. The practice, which is found among groups occupying the territory between Cape Stewart on the Arafura Sea and Blue Mud Bay on the Gulf of Carpentaria, is closely bound up with funerary customs and totemic beliefs. The material is transient as the pigment used is mixed with water, and the skulls, after being carried about by a relative, usually a woman, for a period of two or three years, are pulverized with pounding stones. Hence no record is left which might provide a key to further investigation. Great numbers of the painted designs are employed on ceremonial occasions, each group having an appropriate type for painting the bodies at initiation, after death, and later on the skulls, also on grey-bearded men and upon a man sometime after the conclusion of the final ceremony at which he attains the status of full initiation to the totem group. Each group, sometimes bound together by so slender a thread that it can be understood only by study of mythology, owns distinctive patterns. The right to use these is vested in members of the group only and guarded with the most intense jealousy, as it is bound up with the spiritual and social existence of the group. It is believed that the 'marks' were present on the bodies of the ancestors, when they sank beneath the waters at the sacred places marked to-day by water holes, at which the totemic objects are kept, and to which they are returned at the close of the totemic ceremonies. These are also the places from which emerge the shades of the babies when they enter their mother at conception. The significance of the designs is clearly that they are used in rites of aggregation. Hence the painting of the skull is in the nature of a benediction and a consecration.

Statistics of Literary Style

THE science of statistics, originally restricted to problems of the State, has long been extended from demography and economics to biology and psychology, but it is rather surprising to find it applied to problems of literary style and disputed authorship. When the application is made by such an authority as G. Udny Yule and published in *Biometrika* (**30**, 363; 1938), it cannot be dismissed as a mere curiosity. What Mr. Yule has done is to make an analysis of the sentence-length of certain authors. Thus, for example, Bacon's "Essays" contain three sentences containing 1–5 words, sixteen containing 6–10 words, forty-nine containing 11–15 words, . . . and so on. This forms a frequency distribution, which can be analysed by any of the usual statistical methods. Mr. Yule has selected the mean, median, upper and lower quartiles, interquartile range, and ninth decile. These numbers come out very differently for Bacon, Coleridge, Lamb, and Macaulay. Moreover, if the tests are applied to two fairly long extracts from the same author, on similar subject-matter, they give reasonably consistent results. This seems to show that sentence-length can be taken as a characteristic of the author's style. As an example of the application of these methods, it is shown that the style of "De Imitatione Christi" is consistent with that of Thomas à Kempis, but not with that of Gerson, to whom the work was sometimes attributed. Similar objections are raised against attributing the authorship of "Observations upon the Bills of Mortality" to Sir William Petty.

Habitat of the Lapwing

THE Edward Grey Institute of Field Ornithology, Oxford, has issued in booklet form a hundred pages of reprints from *British Birds* covering the 1937 lapwing habitat inquiry conducted by E. M. Nicholson with the co-operation of fifty-five observers in twenty-six English and one Welsh counties. It did not appear that different geological formations or soils influence very substantially the distribution of this species (*Vanellus vanellus*), but it was not found breeding freely much above 1,200 ft., and steep slopes are generally avoided. The most frequent habitat types are newly ploughed land, fallow and stubble, and fair permanent pasture above alluvial level. Tidal beach or shore, margins of salt or brackish standing water, bare peat and rabbit warrens are little used, and dry shingle, bracken moorland, bare stony mountain, urban public parks and playing fields, scrub with trees and bushes and woodland clearings were avoided. Farming, burning and flooding cause substantial changes in their haunts. Material collected for nesting shows no apparent preference between a wide range of different habitats; flocks may occur at all seasons but are largest in the second half of the year, feeding or roosting in all weather conditions at all times of the day, resting birds often packing closely in some hollow or sheltered slope. Heavy passing traffic and farm workers' movements have little effect upon the bird, nor do wild mammals, birds and livestock have much noticeable effect, but some parasitism by gulls was noted. The lapwing is essentially a bird of the soil, it is noted, and therefore closely linked with agriculture. It is stated there is still scope for further study, including intensive survey work on limited areas, study of flocks over large areas, fifty-field samples at different periods, study of daily time-tables for the species, and study of its diet in relation to other factors. There is appended an important ecological survey by M. D. Lister of the lapwing population on a 225-acre Epsom (Surrey) arable farm, showing annual fluctuations and relations to crops.

Division of Labour among Asiatic Ants

THE workers of the Asiatic carpenter ant, *Camponotus japonicus* var. *aterrimus*, differ greatly in size, but form a continuous series from smallest to largest, although there are some slight morphological differences among them observable, for example, in the proportions of the head. In a series of field observations, Juishüan Lee has endeavoured to classify the activities of the workers in relation to the size grade of the individuals (*Peking Nat. Hist. Bull.*, **13**, 137; 1938). The results show that specialization is much less marked than in some species, for every worker

class was found to share in all kinds of work within the colony. The only difference was that certain activities were performed predominantly by one particular class. Thus large workers took most part in work requiring strength and courage, such as fighting, foraging, guarding and exploring, and also in food regurgitation, which is probably related to foraging. The small workers are most active in carrying, foraging, building, tending the young and carrying the jumping plant-louse. The intermediates are active in all sorts of labours, but always to a moderate extent, neither most active nor most indifferent. Division of labour, therefore, has here no definite specialized castes, but is exhibited as a matter of degree whether expressed in size or in activities.

Response of Leaves to Gravity and Light

LEAVES of terrestrial plants usually tend to orientate themselves so that the upper surface of the lamina is perpendicular to and facing unilateral light. Their reaction to gravity tends to bring the lamina horizontal. The combined stimuli of light, gravity and any others result in a position effecting a compromise. W. Neilson Jones has recently carried out some interesting comparative work on this subject, using the leaves of the terrestrial *Tropæolum majus* and the floating leaves of *Limnanthemum peltatum* (*Ann. Bot.*, New Series, **2**, No. 8, 819; 1938). He found that the leaves of both plants tend to orientate their laminæ in relation to gravity by curvatures of the petioles in such a way as to bring the laminæ into a horizontal plane. On the other hand, leaves of *Tropæolum majus* are also sensitive to unilateral illumination, whereas those of *Limnanthemum peltatum* are not. This reaction to light, he claims, may be expected on biological grounds as a general difference between aerial and floating leaves.

Bacterial Reduction of Nitrates

The mechanism of nitrate reduction in *Bacterium coli* (*Escherichia communior*) has been investigated by Syunzi Yamagata ("Über die Nitratreduktase von Bacterium Coli", *Acta Phytochimica*, **12**, No. 2, 283; Oct. 1938). Several research workers have maintained that the reduction of nitrates is accomplished by the usual dehydrase system of the bacteria. The present experiments with cell-free enzyme preparations show, however, that the reduction is accomplished by two separate enzymes, according to the following plan:

nitrate → intermediate hydrogen acceptor → hydrogen donator

(nitrate reductase; usual dehydrase or dehydrase system)

The two enzymes are shown to be separate mainly upon their varying reactions with potassium cyanide.

Accuracy of Direction Finders

ON March 1, R. L. Smith-Rose, of the National Physical Laboratory, presented a symposium of papers on direction finders to the Wireless Section of the Institution of Electrical Engineers. The first paper on the subject describes an improved medium-wave Adcock direction finder, and was published in 1937 (*J. Inst. Elec. Eng.*, Nov. 1937). Since that date, four papers have been published in the *Journal* and a further one by W. Ross was read at the meeting, all of which discuss direction finders used in wireless. In the operation of radio direction-finding, the user is generally faced with the problem of effecting the best possible calibration of his instrument which circumstances permit. Ideally, an overall calibration would be made by setting up a transmitter at known points in the sector and at the distances for which the direction finder is required to be used. Mr. Ross explains how this is not always possible and the expedient of using calibrations made at one particular distance for transmissions from all distances frequently leads to errors. Part at least of the error revealed by calibration, as for example, the error arising from changes in the medium in which or over which propagation takes place is frequently found to vary considerably with distance. That part of the error which arises from the instrument itself is a constant and if known could always be allowed for accurately. If an ideal overall calibration is not possible, it is best, as a rule, to allow for the instrumental calibration only. The errors due to various causes are discussed mathematically and it is shown how the results obtained can be applied practically. In particular, the case of a four-aerial Adcock direction finder is considered at length. The effects of ground attenuation have been neglected, but on very poor sites the radiation component of the electric field from a short vertical radiation will attenuate with distance more rapidly than inversely as the distance, which has generally been assumed throughout the analysis. The papers presented at this meeting should be a great help in increasing the practical accuracy of direction-finding in navigation.

Galactic Rotation

G. L. CAMM has recently issued a paper entitled "A Study of Galactic Rotation, based on the Velocities of the Planetary Nebulæ" (*Mon. Not. Roy. Astro. Soc.*, **99**, 2; 1938) in which he analyses the radial velocities of the planetary nebulæ to discover the relation between the angular speed of rotation of the galaxy and the galactic radius. A knowledge of the distances of the nebulæ is essential and the method adopted was to use angular diameters and apparent magnitudes, treating them as equally reliable indicators of distances. The method is admitted to be too crude to make any allowance for interstellar absorption or for the effects of selection; but the author shows that the former is of little consequence. From Table 1 it appears that, though the planetary nebulæ are close to the galactic plane, they are affected by interstellar absorption to a very small extent. From the analysis of the radial velocities there are deduced values for the constants of solar motion, the distance and direction of the galactic centre and also a constant K-term. The proper motions of twenty-one planetary nebulæ determined by van Maanen were used to find the linear speed of rotation at the distance of the sun; but the result is unsatisfactory owing to the fact that the proper motions are too few. On the assumption of a linear speed of 275 km./sec. at the sun's distance, the variation of the gravitational attraction of the galaxy is shown to be similar to that arising from a thin circular disk, its density decreasing uniformly outwards, and a massive nucleus existing at the centre of the disk. It is interesting to notice that the best agreement between this model and the observed radial velocities of the planetary nebulæ is obtained if the mass $0{\cdot}76 \times 10^{11}$ is assigned to the nucleus and $1{\cdot}01 \times 10^{11}$ to the disk, the mass of the sun being the unit.

British Industries Fair

As year succeeds year, the visitor to the British Industries Fair, on the lookout for exhibits of scientific interest, finds the range and variety ever greater. Looking back over a period of years, he cannot fail to be struck with the emergence from time to time of entirely new industries, the fruits of scientific research and discovery. Not only so, but also the scope of long-established industries is being continually widened, as new products or new applications of old products are discovered. As one goes through the specifically scientific exhibits or exhibits possessing some scientific interest, one can picture the character and the extent of the prolonged scientific research that must have preceded the eventual production of the materials or articles exhibited.

The chemical industry in particular each year brings before the visitors to the British Industries Fair new products and long-established products manufactured to a still higher degree of purity, to meet modern needs. It may also be remarked that the art of displaying the exhibits seems to improve each year, although the writer noticed in a few cases a tendency, perhaps, to elaborate the framework at the expense of the exhibit framed. On the whole, however, this year marked a distinct advance in what may be called the informative and educative value of the exhibits. For example, this year's main stand of Imperial Chemical Industries, Ltd., at Olympia, consisted of a well-set-out diagrammatic exhibit dealing with the production of ammonia and its varied uses. Displays dealing with water sterilization, the preparation of rubber latex, refrigeration and metal production exhibited the uses of ammonia in its anhydrous form. The uses of ammonia liquor were indicated by references to the manufacture of cuprammonium silk, to toilet ammonia preparations and to laundry and textile processes. Among other sections of this comprehensive exhibit were those dealing with the uses of ammonia converted to cyanide—fumigation by hydrocyanic acid, gold extraction and case hardening—and of ammonia as urea in the manufacture of plastics and in the pharmaceutical trade.

On the stand of Boots Pure Drug Company, Ltd., was a large diagrammatic chart, showing stages in the manufacture of fine chemicals from coal tar. Among organic reagents for metals, Hopkin and Williams, Ltd., showed resacetophenone (dihydroxyacetophenone), a reagent for iron, and dimercaptothiodiazole, a reagent for bismuth, which has now been recommended for the determination of lead tetraethyl in petrols. They also showed for the first time a group of fluorescent indicators, which are recommended for the determination of acidity or alkalinity of strongly coloured solutions which inhibit the use of visual indicators.

Turning to the grouped exhibits of the scientific instrument manufacturers, these, as in the last few years, formed one of the outstanding features of Olympia. It is impossible within the limits of this article to do more than direct attention to a few of the novel products shown this year. Ross, Ltd., exhibited a very remarkable wide-angled survey lens, recently produced. It has an angle of 96° and consists of a five-lens system, in which the separation between the component lenses is 1/1000 in. The lenses are not cemented but held in position by special clips, in order to avoid strain that might be set up by the use of a cemented lens at high altitudes where very low temperatures prevail. Moreover, the system is mounted in stainless steel having a coefficient of expansion equal to that of the glass, so as to avoid any possibility of strain or deformation due to differential temperature changes. As to the performance of this lens, a photograph was exhibited taken from a height of 20,000 ft. covering 40 square miles of London with one exposure, all the streets and main landmarks being easily recognized by the naked eye. This lens is a remarkable achievement, of which the British optical industry may well be proud. It is made of 3½ in. focus upwards and is priced from £250 upwards. Ross, Ltd., also showed a new, extremely lightweight prism binocular with extra-wide field. The effective diameter of the object glass is 30 mm. with a real field of view of 9° and an apparent angle of 63°, and the instrument is provided with central focusing by screw adjustment.

Charles Baker showed a new micrometer measuring microscope, with a travel of 300 mm. (12 in.), reading to 0·01 mm. direct and by estimation to 0·0025 mm. The microscope is mounted on two accurately ground, stainless steel bars on the kinematic principle. The stage is also mounted on the kinematic principle and has coarse and fine adjustment in the vertical direction.

Cooke, Troughton and Simms, Ltd., showed a new geodetic level designed for the Ordnance Survey in conjunction with Major Hotine of that Survey. The body of the telescope is made of metal having the same coefficient of expansion as that of the glass incorporated. The focal length is 13 in. and the aperture of the object glass 2 in. The main spirit level—a split bubble—is read in the field of view of the telescope by the coincident method.

E. R. Watts and Son, Ltd., exhibited a new theodolite, having the following novel features: short but powerful telescope, glass instead of metal circles, the use of an optical micrometer for reading the subdivisions, an optical plummet incorporated in the body of the instrument, and the complete enclosure of the circles and optical system.

Among the exhibits of R. and J. Beck, Ltd., was a combined binocular and monocular microscope, having an inclined eyepiece. It contained means for varying the inter-ocular distance and for the change-over to the monocular without dismantling the lenses. They also showed a new model of the Hartridge reversion spectroscope, designed specially for the physicist. It has a symmetrical slit and is graduated to read direct into Angström units.

Among the exhibits of W. Watson and Sons, Ltd., was an apparatus known as the 'library reader'. By means of a camera a photographic record of, say, a 500-page book can be taken on only 30 ft. of standard cine film. The film can then be projected on to a screen to be read conveniently. One purpose of this apparatus is to render accessible to serious students unique manuscripts and precious early editions of books possessed by libraries, where it would be inconvenient to allow the actual books to be used.

Adam Hilger, Ltd., showed a photometric colour comparator. Its main use is for the maintenance of colour uniformity or the matching of specimen colours in various industries. It makes use of polarizing laminæ, the planes of polarization of which are mutually perpendicular. It is not suggested that this instrument can take the place of a colorimeter of such precision as the trichromatic colorimeter, or of an accurate spectrophotometer, but for the diagnosis of colour faults and for colour standardization within the factory it is claimed to be of great practical value. Messrs. Hilger also showed a projection spectrum comparator. This instrument projects the images of two spectrograms—the spectrum to be interpreted and the standard spectrum—in juxtaposition upon an easily viewed screen, and so avoids monocular observation through an eyepiece. This firm also showed a spectrograph having a flat focal field, so that no adjustment of focus is required for any part of the spectrum. An incidental advantage of the flat photographic plate that may consequently be used is that the thickness of the glass does not matter and the spectrograph is no longer restricted to the use of thin plates.

The most prominent feature of the scientific instruments exhibit, and the one, perhaps, which aroused most interest in the visitors, was the anti-aircraft predictor. This instrument computes mechanically for anti-aircraft purposes the position of an approaching target, such as a hostile bomber. It will be realized that the speeds of modern aircraft are such that it may be necessary to direct the gun as much as two miles ahead of the path of the bomber, if the projectile is to hit the 'target'. The target must be visible to the observer and, therefore, at night must be 'caught and held' by the searchlight. The telescope of the predictor is then laid on to the target and follows it, and as it does so the instrument shows automatically the position and other data required and feeds the gun crew automatically and simultaneously with all the necessary information for firing, including even directions for the adjustment of the shell fuse. To the lay visitor it must have seemed almost like black magic.

Microtechnique in Organic Chemistry

A SURVEY of the most important advances in organic chemistry during the last ten or fifteen years shows that these deal very largely with the chemistry of naturally occurring products. Perhaps the most striking developments are the determination of the structure of the principal vitamins, the very existence of which was debatable fifteen years ago, and the elucidation of the nature of the sex hormones and of the plant growth substances (auxins). No less important, if less spectacular, work has been done on new alkaloids, plant pigments, insecticides and triterpenes.

A point which cannot fail to strike the observer is that the quantities of material available for these investigations are of necessity extremely small. Thus the total amount of auxin used by Kögl in the elucidation of its structure was of the order of one gram, yet the molecule of this compound contains eighteen carbon atoms; and the majority of the other hormones and vitamins are equally or more complex.

These investigations were only made possible by the development in the course of the last two decades of a number of new experimental methods, which have revolutionized the technique of organic chemistry; thus it is now possible to carry out analyses on quantities of about 1/50 of those formerly required, whilst the degree of accuracy and reliability attainable is definitely greater.

In view of what has been said, the symposium on microtechnique held by the Chemical Society on March 2 was particularly timely and a number of new advances were discussed by specialists.

Prof. I. M. Heilbron opened the discussion and gave a general survey of the methods available to the investigator. Of these, quantitative analysis is perhaps the most important; it is to-day possible to carry out exact estimations of carbon and hydrogen, nitrogen, sulphur, halogens and the metals using 2–3 mgm. of material. Molecular weights can be rapidly determined on even smaller amounts of material by Rast's cryoscopic method, and functional groups, such as acetyl, methoxyl and *N*-methyl, can all be determined on quantities of not more than 5 mgm. Active hydrogen can be estimated by the micro-Zerevitinov method, while the modern methods of titration are extremely accurate and can be successfully applied to such compounds as the resin acids and the sapogenins of the C_{30} groups. Finally, the degree of unsaturation can be quantitatively estimated and an apparatus for this purpose, designed for quantities of 1 mgm. or less, was described by Dr. H. Jackson. An improvement of Pregl's microcombustion apparatus, in which rubber connexions have been entirely eliminated without making the apparatus fragile, was demonstrated by Mr. W. F. Boston.

Absorption spectra provide a purely physical method of observation which can be of the greatest service to the chemist, as Prof. Heilbron showed on several striking examples, and necessitates only minute amounts of material. The method is particularly valuable for ascertaining the number and arrangement of unsaturated centres in the molecule; it is indispensable when dealing with the vitamins of the A and D groups, carotenoids, etc. Thus, the constitution of myxoxanthin, $C_{40}H_{54}O$ was established by Heibron and Lythgoe with considerable certainty on the basis of its absorption spectrum although less than a gram of the pure substance was available. The existence of a new vitamin peculiar to the liver oils of freshwater fish was discovered by the spectrographic method and later confirmed by chemical means. At times it is also possible to decide between two alternative types of ring structure, as in the recent instance of α-tocopherol; the extinction coefficient of this compound was found by John to be consistent with a chroman and not a coumaran skeleton.

The determination of molecular weights of solids can be carried out on less than 1 mgm. of material, provided one or two good crystals are available, by an X-ray method which was described by Mr. D. Riley working with Miss D. Crowfoot. The method depends on the accurate determination of certain constants, namely ρ, the density of the solid, V, the volume of the unit cell in the crystal, and n, the

number of molecules in such a unit, when the relationship $\rho = nM/V$ enables us to calculate M (the mass of the individual molecule or the molecular weight × the mass of an atom of hydrogen); n is, of course, a whole number which is dependent on the arrangement of the molecules in the unit cell and can be readily ascertained by a preliminary calculation. The order of accuracy attainable is such that even the number of hydrogen atoms, always an uncertain figure when dealing with large molecules, can be determined; Mr. Riley showed how the new method has been applied to such compounds as the esters of α-tocopherol.

The application of monomolecular films in solving constitutional problems was discussed by Dr. J. Schulman in the absence of Dr. E. Stenhagen. He referred to the new method of Langmuir and Blodgett, which consists in spreading a monomolecular film on water and, by alternately dipping and withdrawing a metal plate, depositing successive 'monolayers' on the metal surface, thus enabling their thickness to be measured by an optical method. From the surface potential and apparent dipole moment measurements it is possible to draw conclusions about the nature and position of the polar groups in the molecule. The area occupied on water gives a measure of the cross-section of the molecule and it is often possible to make deductions as to the shape of the molecule, such as the extent to which a long chain is branched, which would only be possible as the result of elaborate degradation experiments. This was particularly well exemplified by the recent beautiful work on phtoic acid, a toxin derived from the tuberculosis bacillus; the results provide a starting-point for synthetic work in conjunction with biological tests.

Chromatographic adsorption, which was discussed by Dr. A. H. Cook, was discovered by Tswett so long ago as 1906, but its usefulness was not appreciated until it was recently reintroduced by Kuhn, Winterstein and many other workers for the separation of carotenoids. It is essentially a preparative method and its vast scope is only just being realized. In principle it depends on the fact that many substances of comparable solubility in a given solvent differ greatly in their capacity for being adsorbed on a variety of inert materials such as alumina. When a solution containing such substances is allowed to run through a column of the adsorbent, the most readily adsorbed substance is retained nearest the top and the least readily adsorbed is found at the bottom or goes right through. With coloured compounds, such as carotenoids, it is easy to observe the process of adsorption, since rings or zones of colour are produced; the adsorbed substances can then be eluted by changing the solvent or by cutting the column up into sections and extracting each separately. The adsorption of colourless compounds can sometimes be followed by means of ultra-violet light or the zones can be made visible by adding a coloured 'indicator'—a dye of the same degree of adsorbability as the required substance. This ingenious variant of the method was used by Brockmann in the isolation of vitamin D_3 from fish liver oils. The chromatographic method is also extremely useful for the purification of countless organic compounds and has the advantage that practically no material is lost; it can be used on an almost microscopic scale, as in Schöpf's isolation of the colouring matter of butterflies' wings, or adapted to large-scale work.

G. A. R. KON.

Steel Castings

A SESSION of the adjourned Autumn Meeting of the Iron and Steel Institute was devoted to a consideration of the extremely important third report of the Steel Castings Research Committee.

After a short introduction, Section 2 deals with the fluidity of iron-carbon and alloy steels, by Prof. J. H. Andrew, G. T. C. Bottomley, W. R. Maddocks and R. T. Percival; together with other contributions on the Ruff test by T. R. Walker and R. J. Sarjant and T. H. Middleham. The fluidity tests carried out with the standard spiral mould described in the second report of the Committee have been extended and it is evident that in this type of test temperature is the all-important factor, composition itself playing a minor part. An outstanding feature of this paper is the serious attempt made to correlate fluidity with the liquidus and solidus curves. In the Ruff test, where the test piece is a straight rod, there are certain points of difference. As an example, the markedly greater fluidity of Swedish charcoal iron as compared with that of Armco iron of similar composition, indicates strongly that the difference in oxidation of the melt is a by no means unimportant factor. The influence of oxygen is also shown in the erratic results which are obtained when deoxidants, such for instance as aluminium, are added to the steel. Trials of the test have also been carried out on an industrial scale in a large steel foundry, the results indicating that this method of measuring fluidity gives reproducible results which are sufficiently accurate for practical purposes.

Section 3 deals with a report by Martin Alexander on copper-containing steel castings. The effect of 1 per cent of copper has been investigated in cast steels of widely different composition. The results indicate that this metal is a valuable alloying element in such materials. It improves the mechanical properties of the annealed steel and renders the castings susceptible to a hardening treatment which can be carried out at a temperature below the critical range without distortion or the setting up of internal stress. The full effect of the temper-hardening treatment, however, cannot be employed with advantage on account of the accompanying embrittlement. To avoid the undue fall in impact strength it is necessary to provide a sufficiently tough matrix by keeping the carbon content low and to re-heat the casting to a temperature higher than that giving maximum hardness in order to cause some coalescence of the precipitated constituent.

Section 4 is concerned with the strength and ductility of cast steel during cooling in sand moulds from the liquid state. The author, H. F. Hall, has devised a most ingenious, and apparently successful means of determining the susceptibility of the material to give contraction cracks. The test piece is so designed that at some position within it the temperature during cooling is maintained above that of the remainder of

the bar, while a tension is induced at an early stage by the special design of the end conditions.

Section 5, which represents the first report of the Moulding Materials Sub-Committee and extends to something like 120 pages, is a remarkable achievement for the time this Committee has been at work, and certainly represents the most important contribution yet made to the scientific and technological study of moulding sands for steel castings.

The report ends with a bibliography of some ninety pages dealing with the manufacture, properties and testing of steel castings, prepared by the Library and Information Department of the Institute. To all who have been in any way concerned with the work for, and the preparation of this report, wholehearted congratulations may be offered.

Economic Policy in the Twentieth Century

A BROADSHEET, "Twentieth Century Economic Policy", recently issued by P E P (Political and Economic Planning), directs attention to the need for guiding patterns to replace the one-sided patterns of *laissez-faire* and nationalism. The broadsheet largely summarizes the attempt to provide the essentials of such a pattern which are set forth in a memorandum prepared by Prof. N. F. Hall, director of the National Institute of Economic and Social Research. Measures adopted to maintain the volume of employment have checked improvements in the standard of living and new policies are required to raise the several national standards of living without in the process setting up intolerable strains. Recent scientific advances, moreover, justify the assumption that there is a minimum physiological standard of living which can be roughly measured and which is a necessary condition of progress in other directions. The satisfaction of minimum physiological needs can be set as an immediate goal for economic policies without sacrificing other values provided the methods adopted do not infringe individual freedom.

Economic adjustment demands increasing efficiency in the older lines of production to liberate resources and particularly labour for new enterprises. The standards now available for nutrition supply a definite basis for assessing advances and setbacks as regards food. Less exactly approximate minimum standards can be ascertained for clothing, house space, and equipment necessary for physiological well-being under different conditions of climate, etc. The first step towards stable national and international progress is therefore to draw up common standards of a broad and simple character and survey the deficiencies of different countries and regions. Not only is it becoming possible to determine such minimum standards but also to forecast the actual demand for the various products in given conditions of price, income and knowledge. The key to expansion of demand lies in the relation between money incomes of consumers and the unit prices of basic necessities, which determine how much purchasing power will be available to raise consumption of all classes of goods above the level necessary for mere survival.

The cardinal aim of economic policy should thus be to reduce costs and prices of necessities, setting free margins of purchasing power which will in turn lead to reductions in the price of semi-luxuries.

Science News a Century Ago

The Statistical Society and Vital Statistics

IN the annual report of the Council of the Statistical Society, read at the anniversary meeting on March 15, 1839, it was stated that the Committee on Vital Statistics was still engaged in collecting data from which may be deduced the laws of human mortality. With regard to a collection of the experience of the numerous insurance societies, the circulation of the Committee's forms among the several offices had had the effect of inducing a committee of actuaries to renew the prosecution of a previously contemplated plan for collecting the desired information. Such a committee obviously possesses peculiar facilities for the task, the report said, and as the Council had received the strongest assurance that the actuaries had the same object in view as the Society, to which they had promised to communicate the results of their labours, the proposed inquiry had been abandoned. But the Council had received some valuable returns from various medical establishments in reference to the subject, and the forms of registry suggested by the Council had been adopted in important public institutions.

Stephen Peter Rigaud, F.R.S.

ON March 16, 1839, the Oxford astronomer Stephen Peter Rigaud died at the house of his friend Benjamin Lewis Vulliamy, the clockmaker, in Pall Mall, London. Descended from a family of French Protestant refugees, he was born in Richmond, Surrey, on August 12, 1774, his father being Stephen Rigaud (d. 1814), who for many years assisted the Rev. Stephen Demainbray at the King's Observatory at Kew. In 1791, at the age of seventeen years, Rigaud entered Exeter College, Oxford, and he spent practically all the rest of his life at the University. Graduating in 1797, he became a fellow of the College, a tutor and examiner. In 1810 he succeeded Abraham Robertson in the Savilian chair of geometry and was again Robertson's successor in 1827 in the Savilian chair of astronomy, and this he held until his death. Described as "a laborious student, widely read, no mean conversationalist and a copious correspondent", he is remembered for his work as a mathematical antiquary and bibliographer.

The Polypi of the Mediterranean

"THE observations of M. Milne-Edwards on the Polypi of the Mediterranean," said the *Athenæum* of March 16, 1839, "have induced him to conclude, that the horny cartilaginous or calcareous coverings which envelope them, far from being mere external crusts, without any organic connexion with the animals, which produce them, are integrant parts of these beings, and consist of an organised tissue, the substance of which is more or less charged with horny or calcareous matter deposited in it; and the nutrition of which is effected by introsusception. Among all these animals there exists a tendency in their tegumentary and reproductive parts to become hard, and the degree of solidification which these parts attain is the only character by which zoologists can class them, as naked polypi, flexible polypi, etc."

Prof. Henri Milne-Edwards (1800–1885), who was the son of an Englishman, filled the chairs of entomology, zoology and physiology at the Jardin des Plantes, Paris.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 397–472, Feb. 6, 1939).

P. LEJAY : Study of the ionosphere at Shanghai : observation of frequency changes of waves reflected by the ionized layer.

J. MARCINKIEWICZ : The problem of moments.

G. MALÉCOT : Mendelian laws and homogamy. A mathematical discussion.

F. S. I. BALAGUER : A class of transformations of some summability formulæ.

V. A. KOSTITZIN : Compatibility of stable singular points of some algebraic differential equations.

H. CARTAN : Inequalities between the maxima of successive derivatives of a function.

R. D'ADHÉMAR : Mayevski's two equations : remark on the exclusive use of the second.

M. SÉDILLE : Axial compressors and the influence of flow.

L. ESCANDE : Discharge at the downstream end of a weir barrage.

R. REULOS : Maxwell's equations and the *séries de tourbillons*.

M. SCHÉRER : The Pirani gauge : improvements in its use.

A. ROGOZINSKI : New method of stabilization of an electrometer lamp.

R. WARNECKE and MLLE. M. LORTIE : Secondary emission of beryllium.

J. YVON : The ray of the electron.

A. MICHEL and MLLE. M. GALLISSOT : Relation between the magnetic susceptibility and interatomic distances of hydrogenated palladium. Susceptibility and other properties are unaffected by degassing at low temperatures either PdH_4 or PdH (prepared by hydrogenation at − 40°). Difference of susceptibility with hydrogen content seems to be due to change of interatomic distance.

R. DE MALLEMANN and F. GUILLAUME : Magnetic rotatory power of electrolytic ions.

J. COURNOT and MLLE. L. HALM : Corrosion of assemblies [of metal parts]. Results with an ultra-light alloy containing 1·8 per cent manganese.

P. SÜE : Formation of sodium meta-niobate from niobium tetra-oxide and oxygenated salts of sodium.

MLLE. M.-C. BAILLY : Reversibility of the glycero-phosphoric transposition.

F. CAUJOLLE : Thermal decomposition of nickel and cobalt formates.

L. ROYER : Existence of pleochroic haloes in gneisses of the Algerian massif and the geological consequences which follow from it.

E. A. DE LA RÜE : Geological results of an expedition to the coast of French Somaliland.

A. BONTE : Origin and genesis of Oxfordian iron ore of Neuvizy (Ardennes).

A. VIBERT : New formulæ for calculation of yield of [subterranean] sheets of water.

H. HUBERT : African origin of a disastrous tropical cyclone in the region of New York [Sept. 21, 1938].

S. MAZLOUM : The annual components of the rain in Syria and in the Lebanon. There are two regimes, coastal and interior ; a map is given.

R. GARRIGUES : Action of colchicine and of chloral on the roots of *Vicia Faba*. The former influences metabolism without changing cellular structures ; the latter upsets the structure of the nucleus. Both inhibit cell multiplication.

P. C. DE BAILLON : Parthenogenesis of the Tettigoniidæ (Orthoptera).

W. RIESE : The choroid plexus of newly born bears (*Ursus arctos*).

J. WOLFF : New observations on some biological phenomena of oxidation and of reduction. A substance obtained by benzene extraction of dried green plant material is used as a sensitizer of absorbent paper moistened with a solution of orcine. The orcine is oxidized in sunlight and the oxide reduced again by interposition of an opaque body.

A. BESREDKA : Antitetanus serotherapy by the cutaneous route. Antitetanus serum applied to the scarified skin of a guinea pig is completely effective. If the skin is not scarified, it seems to be partially effective.

Brussels

Royal Academy (*Bull. Classe Sci.*, **24**, No. 12, 1938).

B. GAMBIER : A configuration of three conics.

M. LINSMAN : Certain topological involutions (2).

R. BAILLY : Use of the infra-red in the study of minerals. Description of apparatus for the determination of the refractive indices and other optical properties of minerals with the aid of infra-red radiation. Results for stibnite and molybdenite.

J. E. VERSCHAFFELT : Application of the principles of thermomechanics to fluids in steady motion.

P. VAN RYSSELBERGHE : Note on the energetics of photo-chemical, chemiluminescent and electro-chemical reactions.

R. VANDENDRIES : Multiple aspects of sexuality in mushrooms.

Prague

Czech Academy of Sciences and Arts, November 25.

Z. BAŽANT : Theory of a cylindrical wall with a variable radial pressure.

J. KOMÁREK : A supplement to the problem of gut myiases.

J. MILBAUER : Catalysts for the reaction of acetylene with sulphuric acid.

J. MILBAUER : An anomaly in the system acetylene, sulphuric acid, selenium and selenium dioxide. At 100° C. selenium dioxide acts as a positive catalyst in being reduced by acetylene to selenium and oxidized by sulphuric acid to the dioxide.

J. MILBAUER : Two cases of the equilibrium of selenium and its dioxide in catalysis of the reduction of sulphuric acid.

V. HOVORKA : The estimation of molybdenum by vanilidene – benzidene.

V. HOVORKA : Estimation of tungsten by vanilidene – benzidine.

V. HOVORKA and V. SÝKORA : Isonitroso-*N*-phenol-3-methyl-5 pyrazolone used as an analytical reagent.

ZD. KÖCHER : An experimental study of the anthelminthic effect of duodecylalcohol.

M. PRADÁČOVÁ : Favositidæ from the Devonian of Čelechovice.

A. ŠÍRKOVÁ : Mushrooms from Kopřivnice.

J. WOLF : Finger-nail sheets in the light of relief pictures.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Tuesday, March 14

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute), at 5.30.—J. B. Howell: "The Preservation of Child Life".*

BRITISH ASSOCIATION OF CHEMISTS (LONDON SECTION) (in the Conway Hall, Red Lion Square, W.C.1), at 8.—Prof. J. B. S. Haldane, F.R.S.: "Heredity, Chemistry and Politics".*

Wednesday, March 15

ROYAL INSTITUTION, at 5.15.—Prof. F. G. Donnan, F.R.S.: Ludwig Mond Memorial Lecture.

Friday, March 17

ROYAL INSTITUTION, at 9.—Dr. W. H. Hatfield, F.R.S.: "New Researches in Steel Metallurgy".

Appointments Vacant

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MATHEMATICS in the Rugby College of Technology and Arts—P. I. Kitchen, 61 Clifton Road, Rugby (March 16).

TEACHER OF ENGINEERING, MATHEMATICS, SCIENCE AND DRAWING in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77 George Street, Oxford (March 17).

LECTURER IN MATHEMATICS AND ELEMENTARY PHYSICS in the Polytechnic, Regent Street, W.1—The Director of Education (March 20).

UNIVERSITY PROFESSOR OF THE PATHOLOGY OF MENTAL DISEASE in the University of London—The Academic Registrar, University of London, Senate House, W.C.1 (March 23).

ASSISTANT in the University of London Observatory—The Director, University Observatory, Mill Hill Park, N.W.7 (March 24).

SENIOR ASSISTANT in the Department of Mining, School of Metalliferous Mining (Cornwall), Camborne—The Secretary (March 29).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Publications of the International Tin Research and Development Council. No. 88: The Influence of Fluxes on the Spreading Power of Tin Solders on Copper. By Dr. A. Latin. Pp. 12. (Greenford: International Tin Research and Development Council.) Free. [132

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council, by H. Dent Gardner; with Meteorological Notes and Tables for the Year 1938, with Mean Values for 65 Years (1871–1935), by W. Tregoning Hooper. Pp. 16. (Falmouth: Falmouth Observatory.) [142

Publications of the International Tin Research and Development Council. No. 89: Tin and its Alloys in Dental Practice. By F. C. Thompson and N. Wild. Pp. 18. (Greenford: International Tin Research and Development Council.) Free. [152

Metropolitan Water Board. Thirty-second Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended 31st December 1937. By Lt.-Col. C. H. H. Harold. Pp. 104+6 plates. (London: P. S. King and Son, Ltd.) 10s. 6d. [152

Imperial College of Science and Technology: City and Guilds College. Research financed from Clothworkers Company's Grant, 1937–38. Pp. 17+12 plates. (London: Imperial College of Science.) [162

Other Countries

Annuaire de l'Académie Royale de Belgique, 1939. Cent-cinquième année. Pp. 160+390+10 plates. (Bruxelles: Palais des Académies.) [82

The Engineering Foundation: a Department of United Engineering Trustees, Inc. Annual Report, October 1, 1937, to September 30, 1938. Pp. 48. (New York: Engineering Foundation.) [132

India Meteorological Department. Meteorological Organisation for Airmen. (M.O.A. Pamphlet, 1939.) Pp. v+66. (Delhi: Manager of Publications.) 1.2 rupees; 1s. 9d. [132

Journal of the Indian Institute of Science. Vol. 21 A, Part 37: Dissociation Constants of *Ortho-*, *Meta-* and *Para*-Hydroxy Benzoic Acids, Gallic Acid, Catechol, Resorcinol, Hydroquinone, Pyrogallol and Phloroglucinol. By C. T. Abichandani and S. K. K. Jatkar. Pp. 417–442. 1.12 rupees. Vol. 21 A, Part 38: Esterification Equilibria in Vapour Phase; Equilibrium between Methyl Alcohol, Acetic Acid, Methyl Acetate and Water. By S. K. Kulkarni Jatkar and N. G. Gajendragad. Pp. 443–448. 10 annas. Vol. 21 A, Part 39: Activity of Different Catalysts for Vapour Phase; Esterification. By S. K. Kulkarni Jatkar and R. K. Valvekar. Pp. 449–454. 10 annas. Vol. 21 A, Part 40: Supersonic Velocity in Gases and Vapours. Part 2: Supersonic Satellites in Vapours. By S. K. Kulkarni Jatkar. Pp. 455–466. 1 rupee. Vol. 21 A, Part 41: Equilibrium in Electrodeless Discharge. Part 6: Influence of Rate of Flow on the Formation of Ozone in the Siemen's Ozoniser. By R. Krishnan and S. K. K. Jatkar. Pp. 467–476. 12 annas. Vol. 21 A, Part 42: Supersonic Velocity in Gases and Vapours. Part 3: Volume Resonance in a Supersonic Interferometer. By S. K. Kulkarni Jatkar. Pp. 477–488. 14 annas. Vol. 21 A, Part 43: Activation and Clarifying Properties of Fuller's Earth. Part 5: Dehydration of Fuller's Earth. By B. S. Kulkarni and S. K. K. Jatkar. Pp. 489–504. 1.2 rupees. (Bangalore: Indian Institute of Science.) [122

Contributions from the Biological Laboratory of the Science Society of China. Zoological Series, Vol. 12, No. 7: On some Points concerning the Functions of the Mammalian Cerebral Cortex. By Chi Ping. Pp. 107–130. Zoological Series, Vol. 12, No. 8: Study of some Forest Insects of Nanking and its Vicinity, Part 1. By C. P. Miao. Pp. 131–182. Zoological Series, Vol. 12, No. 9: Birds of Nanking and its Vicinity, Part 1: Passeriformes. By L. T. Chong. Pp. 183–374. (Shanghai: Science Society of China.) [122

Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich. Heft 14: Ergebnisse der Internationalen Pflanzengeographischen Exkursion durch Marokko und Westalgerien, 1936. Redigiert von E. Rübel und W. Lüdi. Pp. 258+17 plates. (Bern: Hans Huber.) 12.50 francs. [132

Egyptian University. Bulletin of the Faculty of Science, No. 14: The Osteology of the Lizard *Scincus scincus* (Linn.). By M. R. El-Toubi. Pp. 38. (Cairo: Egyptian University.) [142

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